The Welding Engineer

Founded by L. B. Mackenzie, 1916

MAY, 1926 — VOL. 11, No. 5

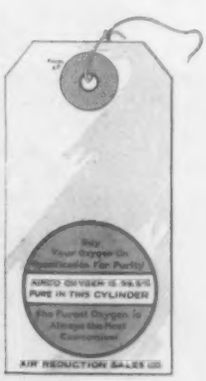
$3.00 per year in U. S. — 608 S. Dearborn St., Chicago, Ill. — Reg. U. S. Pat. Office — $4.00 per year abroad

When you use a cylinder of oxygen bearing this stamp

CONTENTS

AIRCO OXYGEN 99.5% PURE

You have a 10% saving in time and a 10% saving in oxygen, compared with oxygen of one-half of one per cent (0.5%) less purity in metal cutting.



As evidence that a company with national distribution is giving to you the opportunity to profit by the higher efficiency of 99.5% oxygen, your Airco oxygen cylinders will be marked with this tag guaranteeing the quality of the oxygen contained in the cylinder.

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Putting a locomotive through a furnace door

THAT'S what a standard C-6 cutting blowpipe does to a locomotive that is ready for the scrap heap. Not only will Oxweld blowpipes cut the metal efficiently, but Oxweld service men have worked out a method of scrapping a locomotive with the minimum number of cuts.

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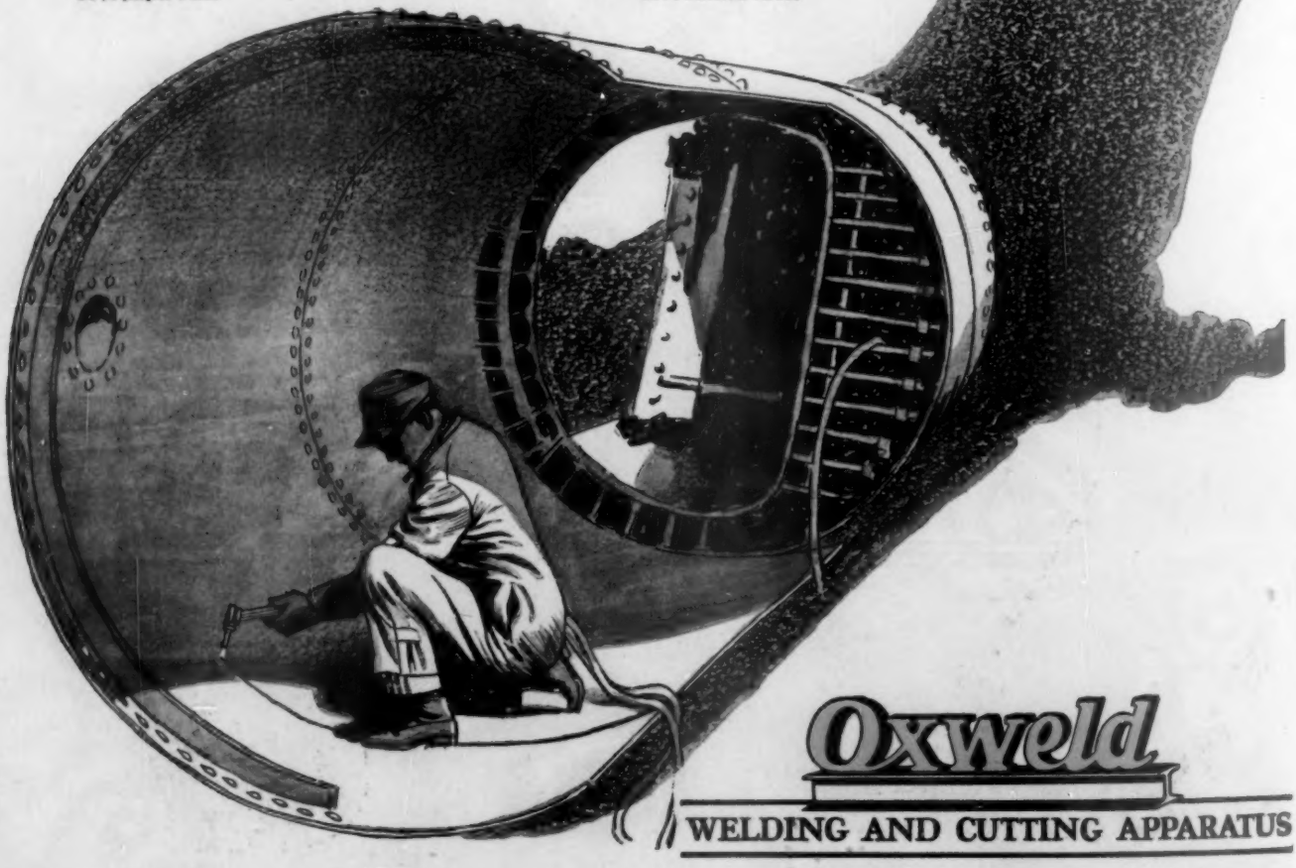

Oxweld

WELDING AND CUTTING APPARATUS

WELDERS

LEAD BURNERS

REGULATORS

SPECIAL BURNERS

Announcement

THE HARRIS CALORIFIC COMPANY
CLEVELAND, OHIO
AND
UNITED STATES WELDING COMPANY, Inc.
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HAVE BEEN CONSOLIDATED
AS OF APRIL FIRST
NINETEEN HUNDRED TWENTY-SIX

TANK VALVES

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The Welding Engineer

Founded by L. B. Mackenzie, 1916 — Reg. U. S. Pat. Office

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WHEN you read the old slogan which says that it pays to advertise it is worth while to keep in mind that advertising pays not only the manufacturer but also the user of the product advertised. The expression has generally been accepted to mean simply that advertising is a profitable investment because it helps to build business and there is no question but that it is the case when the advertiser makes intelligent use of his space. On the other hand, consider that the manufacturer who tells a definite story regarding the merits of his product is bound to supply a product which lives up to his story or he will very soon pass out of the picture. His statements regarding the merits of his products come very close to constituting a contract to supply exactly what he describes and in many cases his advertisements are so worded that they actually are as effective as such a contract would be. When you purchase the advertised product you know that you are buying from a manufacturer who will go far to retain the good will which he has purchased with his advertising.

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The Welding Engineer does not publish in its news or advertising columns any matter that deals with or refers to either personal or legal controversies.

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Buyers' Index

Readers of The Welding Engineer will find this index to contain the most accurate information obtainable relating to welding apparatus and supplies. The advertising section includes the principal manufacturers of the United States.

ACETYLENE (Compressed in Cylinders)
Air Reduction Sales Co.
Commercial Acetylene Supply Co.
International Oxygen Co.
Prest-O-Lite Co.

ACETYLENE CYLINDERS
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Heylandt Sales Co.

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Alumino-Thermic Corporation

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General Electric Co.
Westinghouse Elec. & Mfg. Co

APRONS (Asbestos)
Ideal Face Shield Co.
Safety Equipment Service Co.

ASBESTOS INSULATED WIRE AND CABLE
Central Steel & Wire Co.

BLOW PIPES
See "Torches."

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The Welding Engineer Pub. Co.
Electric Arc Cutting & Welding Co.

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Alexander Milburn Co.
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Hoke, Inc.
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United States Welding Co.

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American Brass Co.
Central Steel & Wire Co.
Steel Sales Corp.

BUFFERS
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Wodack Electric Tool Corp.

CABLE (Arc Welding)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
C. H. Hollup Corp.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.

CARBIDE
Air Reduction Sales Co.
Shawinigan Products Corp.
Union Carbide Sales Co.

CARBIDE (Compressed in Cakes)
Carbic Mfg. Co.

CARBON (Blocks, Paste, Electrodes, etc.)
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National Carbon Co.
Oxweld Acetylene Co.
U. S. Welding Co.

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Hoke, Inc.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
U. S. Welding Co.

CONSULTING ENGINEER
E. F. Hollinger

CONTROLLERS (For Arc Welders)
Electric Welder Controller Co.

CUTTING ELECTRODES (Electric Arc)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
National Carbon Co.
Una Welding and Bonding Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

CYLINDERS (Acetylene)
Keith Dunham Company

CYLINDERS (Oxygen, Hydrogen)
Wm. Wharton, Jr. Co.

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N. A. Strand & Co.
Wodack Electric Tool Corp
Stoody Company

ELECTRIC ARC WELDING OUTFITS
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Electric Arc Cutting & Welding Co.
General Electric Co.
Goodman Electric Machinery Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
H. E. Steinbock
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

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See "Cutting Electrodes"

ELECTRODES (Metallic Arc Welding)
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Chicago Steel & Wire Co.
Electric Arc Cutting & Welding Co.
General Electric Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Page Steel & Wire Co.
H. E. Steinbock
Reid-Avery Co.
Roebling, John A., Sons Co.
Steel Sales Corp.
Seneca Wire & Mfg. Co.
Stoody Co.
Stulz-Sickles Co.
Una Welding and Bonding Co.
Welding Materials Co.
Welding Service Co.
Wickwire-Spencer
Wilson Welder & Metals Co.

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General Electric Co.
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H. E. Steinbock
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Una Welding and Bonding Co.
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Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

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Elkon Works, Inc.

ELECTROLYTIC OXYGEN AND HYDROGEN GENERATING EQUIPMENT
International Oxygen Co.

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General Electric Co.
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Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Safety Equipment Service Co.
H. E. Steinbock
Strauss & Buegeleisen
Una Welding and Bonding Co.
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

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Air Reduction Sales Co.
American Brass Co.
Central Steel & Wire Co.
Oxweld Acetylene Co.
C. H. Hollup Corp.
Page Steel & Wire Co.
Reid-Avery Co.
Roebling, John A., Sons Co.
Steel Sales Corp.
Seneca Wire & Mfg. Co.
Stoody Co.
Stulz-Sickles Co.
Torchweld Equipment Co.
Wickwire-Spencer

FIREPROOF PLASTIC MATERIAL
Air Reduction Sales Co.
Joseph Dixon Crucible Co.
National Carbon Co.
U. S. Welding Co.

FLUE WELDERS (Electric)
General Electric Co.

FLUXES
Air Reduction Sales Co.
Bastian-Blessing Co.
Anti-Borax Compound Co.
Hoxite Co.
Metal & Thermit Corp.
Central Steel & Wire Co.
Oxweld Acetylene Co.
Phillips-Laffitte Co.
Torchweld Equipment Co.

GLOVES (Asbestos)
Ideal Face Shield Co.
Safety Equipment Service Co.

GAUGES
National Gauge & Equipment Co.
U. S. Gauge Co.

GENERATORS (Acetylene)
Air Reduction Sales Co.
Bastian-Blessing Co.
M. Keith Dunham
Imperial Brass Mfg. Co.
Milburn, Alexander Co.
Oxweld Acetylene Co.
U. S. Welding Co.

GOGGLES
American Optical Co.
Ideal Face Shield Co.
Safety Equipment Service Co.
Strauss & Buegeleisen

GRAPHITE (Rods, Blocks, Paste, Etc.)
Joseph Dixon Crucible Co.

GRINDERS (Portable Electric)
N. A. Strand & Co.
Wodack Electric Tool Corp.
Stoody Company

HELMETS (Arc Welding)
Allan Mfg. & Welding Co.
Electric Arc Cutting & Welding Co.
Fibre-Metal Products Co.
General Electric Co.
C. H. Hollup Corp.
Ideal Face Shield Co.
Indianapolis Switch and Frog Co.
Lincoln Electric Co.
Safety Equipment Service Co.
H. E. Steinbock
Strauss & Buegeleisen
Welding Service Co.
Westinghouse Elec. & Mfg. Co.
Wilson Welder & Metals Co.

HYDROGEN
Gas Products Association
International Oxygen Co.

HYDROGEN GENERATING PLANTS
International Oxygen Co.

LEAD WELDING UNITS
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Harris Calorific Co.
Hoke, Inc.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
U. S. Welding Co.

"My Men Always *Want* Wilson Wire"

Use Wilson Type S Machine

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"I really can't afford to use any other wire than Wilson. In the first place, my men *want* Wilson Wire. They know we can get them a grade* of Wilson Wire that's just *right* for any kind of welding they have to do. In the second place, they *know* that no matter what grade*, it will run uniform right through. The result is that when we use Wilson Wire our men have no alibis, and don't need any."

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Every man who has had any experience with Wilson Wire will tell you the same thing. He'll tell you that he can select the correct grade (analysis) of Wilson Wire for the kind of metal he's welding—and that *every rod will be just like every other rod* in the grade selected. This means practically perfect welding jobs.

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Oxweld Acetylene Co.
Stevenson Distributing Corp.
Torchweld Equipment Co.
U. S. Welding Co.

MANIFOLDS
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Carbic Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
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Torchweld Equipment Co.
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Wilson Welder & Metals Co.

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Carbic Mfg. Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
United States Welding Co.

NITROGEN
Air Reduction Sales Co.
Gas Products Association
Linde Air Products Co.
International Oxygen Co.

OXYGEN
Air Reduction Sales Co.
Gas Products Association
International Oxygen Co.
Linde Air Products Co.

OXYGEN PRODUCTION PLANTS
Keith Dunham Company

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Metal & Thermit Corp.

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Wodack Electric Tool Corp.

REGULATORS
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Bastian-Blessing Co.
Carbic Mfg. Co.
G. & G. Brass Mfg. Co.
Harris Calorific Co.
Hoke, Inc.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
United States Welding Co.

SCHOOLS (Correspondence)
Kerr's Welding School

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Collins Stamp Mfg. Co.

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Carbic Mfg. Co.
Harris Calorific Co.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
United States Welding Co.

THERMIT WELDING
Metal & Thermit Corp.

TORCHES (Welding and Cutting)
Air Reduction Sales Co.
Bastian-Blessing Co.
Carbic Mfg. Co.
Harris Calorific Co.
Hoke, Inc.
Imperial Brass Mfg. Co.
International Oxygen Co.
K-G Welding & Cutting Co.
Milburn, Alexander, Co.
Oxweld Acetylene Co.
Torchweld Equipment Co.
Welding Service Co.
United States Welding Co.

TRUCKS (Cylinder)
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Bastian-Blessing Co.
Carbic Mfg. Co.
International Oxygen Co.
Oxweld Acetylene Co.
Welding Service Co.
Torchweld Equipment Co.

VALVES
Air Reduction Sales Co.
Bastian-Blessing Co.
International Oxygen Co.

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Joseph Dixon Crucible Co.
National Carbon Co.
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The Welding Engineer 608 S. Dearborn St., Chicago

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See Letter Below

Bradford Pa.
Nov. 30—1925.

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Cleveland, Ohio.
Attn. of Mr. A. F. Davis.

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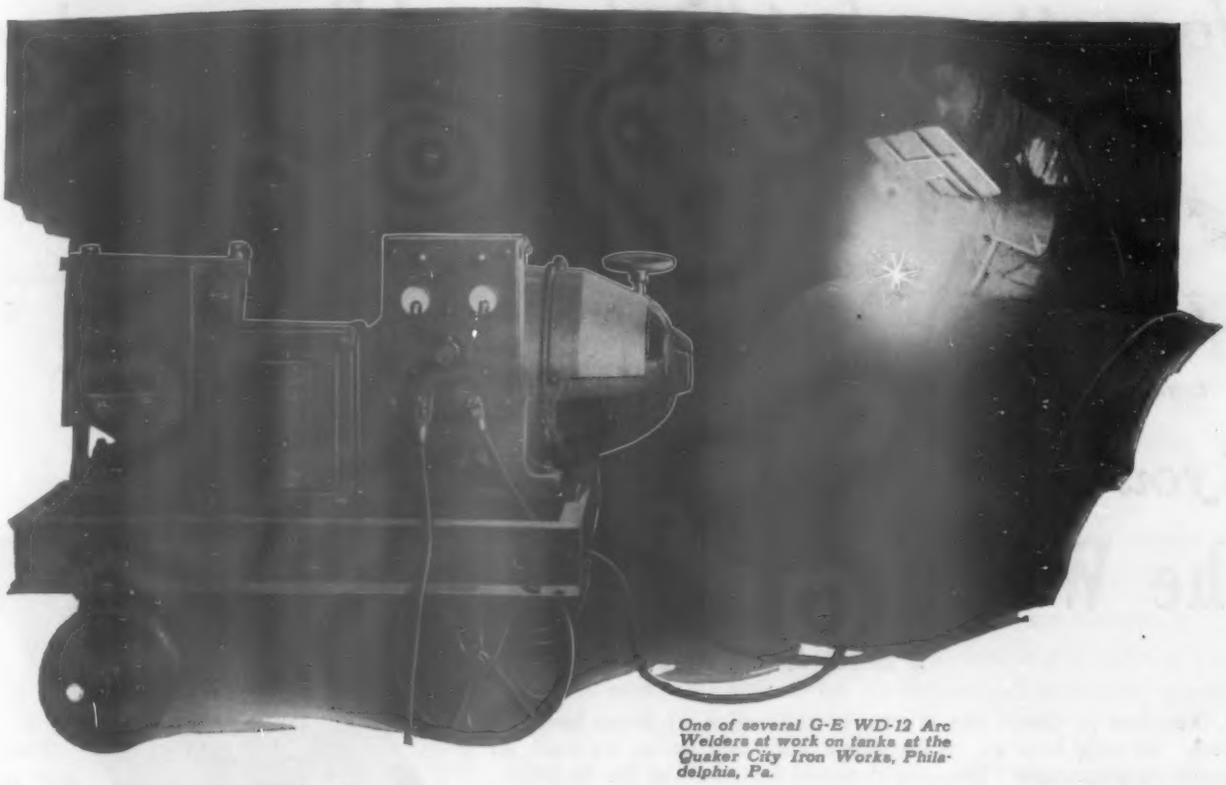
Very Sincerily Yours
J. F. Schumacher

The Lincoln Electric Co., Cleveland, Ohio



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1. Illustrated encyclopedia covering all words, terms, and trade names used in welding.
2. Oxy-Acetylene Welding.—Aluminum, Steel, Cast Iron, Brass, Bronze. (Full instructions for welding each of these metals.)
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Grade No. 20 Brown Tipt: Used on bronze, brass and light gauge copper. Use reverse polarity. For flat work only.

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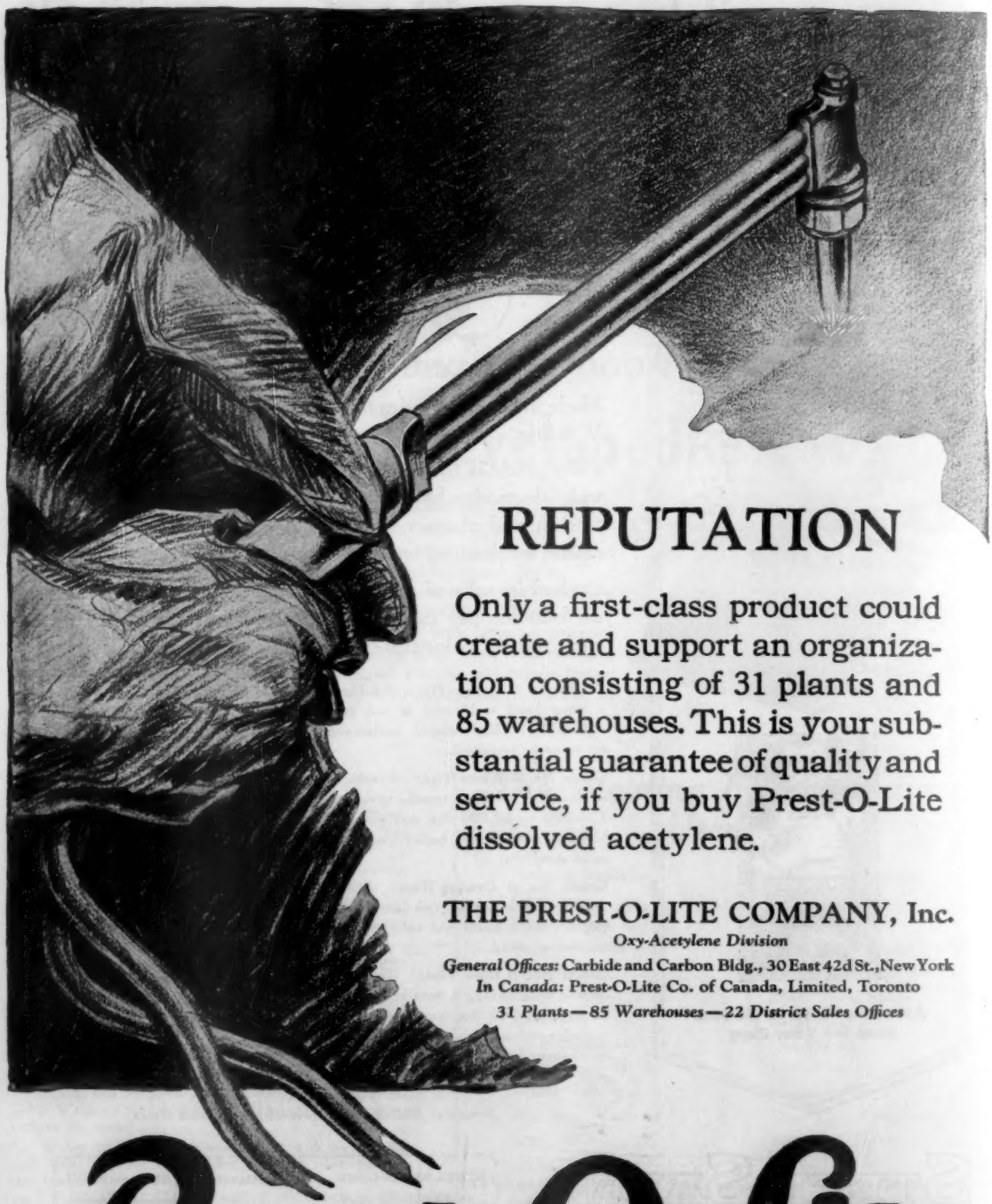

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EDITORIAL

The Human Element

REGARDED by many as the most difficult problem encountered in welding operations, the human element, is after all, no more of a bugbear here than in any other industry. Results are bound to be uncertain if methods are left up to workmen who are accepted at their own valuation. Plenty of welding superintendents, however, will laugh at the idea of finding anything troublesome in the "human element." Their work goes on smoothly and efficiently, and their results are satisfactory. They have few failures and no labor troubles. It is all because they know what good welding is and how to get it done. They cannot compete with their own men, perhaps, on actual operations, but hey know enough about the process to select proper materials, design joints of the right kind, and pick men who know the work. Poor welders either improve or are taken off the job. Good ones stick and become better. When it is necessary to train welders they are trained to do work of the required quality. Labor turnover is kept at a minimum and uniform results are secured. Men working under such supervision acquire a degree of skill far beyond that of the usual welding "expert." In fact, wherever the human element is considered a problem, intelligent supervision will generally prove to be its complete solution.

Tell Them How To Do It

A GREAT deal of argument has been brought to bear on engineers and fabricators of metal products to prove that welding is an economical and efficient process. The opportunity offered for expansion in the structural steel field has, in fact, been made a subject of especially vigorous sales effort but when a man in that field recently remarked that all of the information which he had been given so far consisted of sales talk, he was not far from the truth. The designer may have full confidence in the virtue of the welded joint but if he does not know how to use that joint he is obliged to fall back on conventional methods when making plans for steel constructions. Compared to the amount of engineering information which is actually needed, there is almost nothing available at the present time. The reason is that for most of the work which is being done at the present time standards and specifications are lacking. Each engineer lays out the work according to his best convictions. The universal acceptance of the welded joint will not be possible until it is possible to provide standard specifications for carrying out the work. This means close study of current operations and comparisons of different features of design to the end that some time in the future it will be possible to talk about how to do the welding job as well as how satisfactory the job will be if it is welded. In some instances engineering data regarding particular lines of work have been very carefully compiled and are available for use. The results which have followed their use have been almost universally satisfactory, which in itself is an indication that it will pay to enlarge the effort which is now being made to put welding on a systematic basis.

They See It Coming

THERE are some fields in which the advancement of welding is said to be considerably hampered by the attitude of union labor toward the process, but the unions need not necessarily be an obstacle. One case was recently reported where a business agent, after seeing the completed work on an important contract where welding took the place of riveting, remarked to a young man who was interested in the job that he would welcome an opportunity to secure more information about this welding process. He admitted frankly that he could see the process coming forward rapidly; that there was a definite demand for it which would have to be met in the near future and that it was the intention of his own organization to work for the preparation of their own men so that they would be available as operators on future jobs in that locality.

The Invisible Process

WELDERS in large plants and small plants are performing welding operations in full view of many other workmen and in full view of foremen and supervisors. Yet to most of those who casually observe the work being done the process itself is entirely invisible. They see the prepared joint and they see the finished joint after the weld has been completed but the intense glare of the molten metal surrounded by the arc flame or the torch flame prevents them from seeing the vital part of the work. In this manner many men come to feel that they are thoroughly familiar with welding, when the truth is that they have absolutely no knowledge of what the welder accomplishes. This accounts for many of the misconceptions which have arisen regarding welding, including the idea that welding is a simple operation. It is probable that very much goes on which the welder himself is not able to see and this is a fine point in the training of new operators. No man has been properly trained who does not know exactly how the puddle looks when it is being correctly carried along the joining.

Give the Schools a Lift

WELDING schools are receiving more attention and cooperation than has ever been possible before. More material is available for their use. More is known of their requirements. More recognition is given to their importance. There are several schools in this country which are capable of turning out well trained men as far as fundamentals are concerned. A good many more are struggling along, doing the best they can, and offering an opportunity to local welding enthusiasts to do some constructive work for the benefit of the industry. Motion pictures can be secured for them. Lecturers can be called in to talk on special subjects. Demonstrators can be sent occasionally to teach some of the fine points of welding. In some of the better schools factory demonstrators work on a regular program in this manner. Inspection trips to good welding departments can often be arranged, and are instructive. Cooperating with existing schools is going to help somebody. If an individual does it, the individual will benefit, and if an organization does it, the organization will benefit. If your local welding school is not doing good work, whose fault is it?

Avoid Unnecessary Skimping

IF WELDING pays for itself when given its best chance, why jeopardize results by "skimping" the job in order to get a trifling percentage added to the savings? Such practice is the cause of a majority of cases reported where someone "tried welding but is having all kinds of trouble." Get good men, pay them what they are worth, use good equipment and materials, don't skimp, and you will find every welding process exactly as good as the claims made for it by its representatives.

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The latest addition to Linde service is Procedure Control. Each Procedure Control describes in detail every step necessary to the successful completion of some welding or cutting operation. With the help of a Procedure Control, your own organization can carry on that intricate job.

THE WELDING of sheet metals has advanced so rapidly and has been successful in so many industries that it became necessary to work out many new methods. Such metals as sheet aluminum and sheet monel, in addition to different thicknesses of sheet steel, required modifications of welding technique. Linde Procedure Controls on these subjects make available to Linde customers the most efficient methods of welding sheet metals and assure them of uniform and consistent results.

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LINDE OXYGEN

Arc Welding Heavy Copper Castings

How Copper Blast Furnace Castings are Repaired by the Metallic Arc Process — Work Has to be Kept Hot for Welding

By P. M. Rauscher*

IN the cooling system of a Blast Furnace a great number of copper castings are used through which water flows. These castings have in some plants been welded successfully; in other plants not. Almost invariably you find the oxy-acetylene process being used, either bronze welding such castings, or using a pure copper welding rod with results that are not always satisfactory.

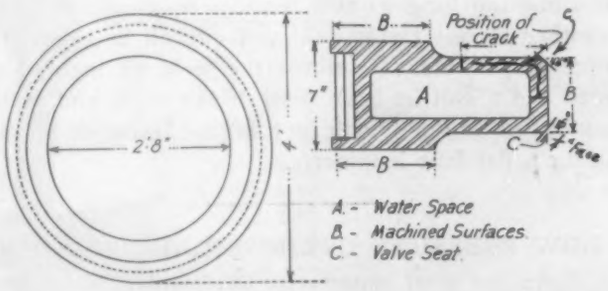
In this mill there had been one type of casting (shown in sketch No. 1) that we had never been able to weld successfully. Either the weld cracked, or pulled another crack near it, and almost always considerable distortion resulted from heating. These castings are used as a water cooled valve seat in a blast furnace stove, machined on three sides, and any warping will render the valve seat unfit for service. As an experiment we tried the metallic arc, with results that exceeded our highest expectations. Namely, the weld was absolutely water tight; no line of demarkation was visible after machining and the casting was not warped. No adhesion was found in the weld and no trouble was encountered with oxides. Last but not least, the cost was reduced fully 20 per cent.

We are now welding all of the copper blast furnace castings by the metallic arc. Some of these castings are shown in the pictures. One of these tuyeres was so bad it was not worth welding and was marked "scrap." Here follows the procedure used in welding the large circular valve seat:—

First: The casting is tested to locate the crack it it is not already visible, then chipped out using an air hammer. Caution: Don't chip too near the bottom of the crack, as when welding the arc will burn holes through and these are hard to fill up. Sand blast to remove all impurities and scale in the vicinity of the weld.

Second: The casting is then annealed, before welding, locally about eight inches on either side of the crack, to enable the casting to withstand the welding strains. A loosely constructed brick furnace is built around the casting and heated to about 400 degrees Fahr., then quenched in water. The heating is done with natural gas and compressed air.

Third: The welding—the casting is again heated to a blood red and welded. After welding and while the casting is still red, use the flat side of a machinist's hammer and peen the weld lightly, and again cool by quenching. (Testing under hydrostatic pressure of 100 pounds failed to disclose any leaks in the weld.) Small cracks and pin holes in the casting are caulked shut using boiler makers' hand roughing tools.



Details of Job

Fourth: Filler rod and welding generator. The welding wire used was Wilson Color-Tipt No. 20. Not recommended for heavy copper but by sufficient pre-heating it gets results. Slightly higher current was used than was advised—180-200 amperes with reversed polarity.

An arc length of 30 volts was used. This is an extremely long arc and requires a welding generator of the utmost flexibility to hold such an arc consistently. A shorter arc than this causes the metal to splash and sputter. Immediately upon lengthening the arc the metals flow fast and steady through the arc and settle into the arc crater producing a very smooth bead.

The welding generator was of the Lincoln Stable-Arc type and surely behaves like a thoroughbred, delivering a 30-volt arc without a falter.

*Pittsburgh Steel Co., Monessen, Pa.

Views of Welding on Heavy Copper Castings

In welding the smaller castings they are heated all over to a blood red and quenched after welding. In pre-heating a little care should be used. A loosely constructed furnace of brick is used. Start to heat the casting with a small flame until the casting gets thoroughly warm and the steam has had time to work out of the pockets and blow holes in the castings. If you heat it too fast, steam pressure builds up in these pockets and cannot escape fast enough through the pin holes, and blows a hole in the casting. This means more welding and sometimes in a very difficult place to get at. Wait until the casting gets very warm for perhaps five or ten minutes then turn on the heat and heat it fast until a blood red heat is obtained. If the welding takes a little too long and the casting cools to a red that can only be seen in the shadow—stop welding and heat to a blood red again. These small castings are not annealed previous to welding, but quenched immediately after. Do not have a casting in the fire too long as this usually develops cracks in another place. Heat, weld and quench in as short a time as possible. Reinforce the weld an inch to an inch and a half on both sides of the crack and three-sixteenths to one-fourth inch high. Hammer lightly, using a flat face hammer.

LOW PRESSURE CYLINDER ARC WELDED

There was great perturbation on Saturday, March 20th, because at the Flintkote Company's plant at Little Ferry, N. J. a low pressure cylinder of a 900 H.P. engine had an accident in which the entire top of the cylinder was blown off.

It appears that the full boiler pressure was put into the low pressure cylinder by some means unknown and the result was that 1½ in. thick cast iron top was blown into several fragments and entirely ruined. Fortunately, no one was seriously hurt although five men were in the engine room at the time, but to get a new cylinder would have taken months.

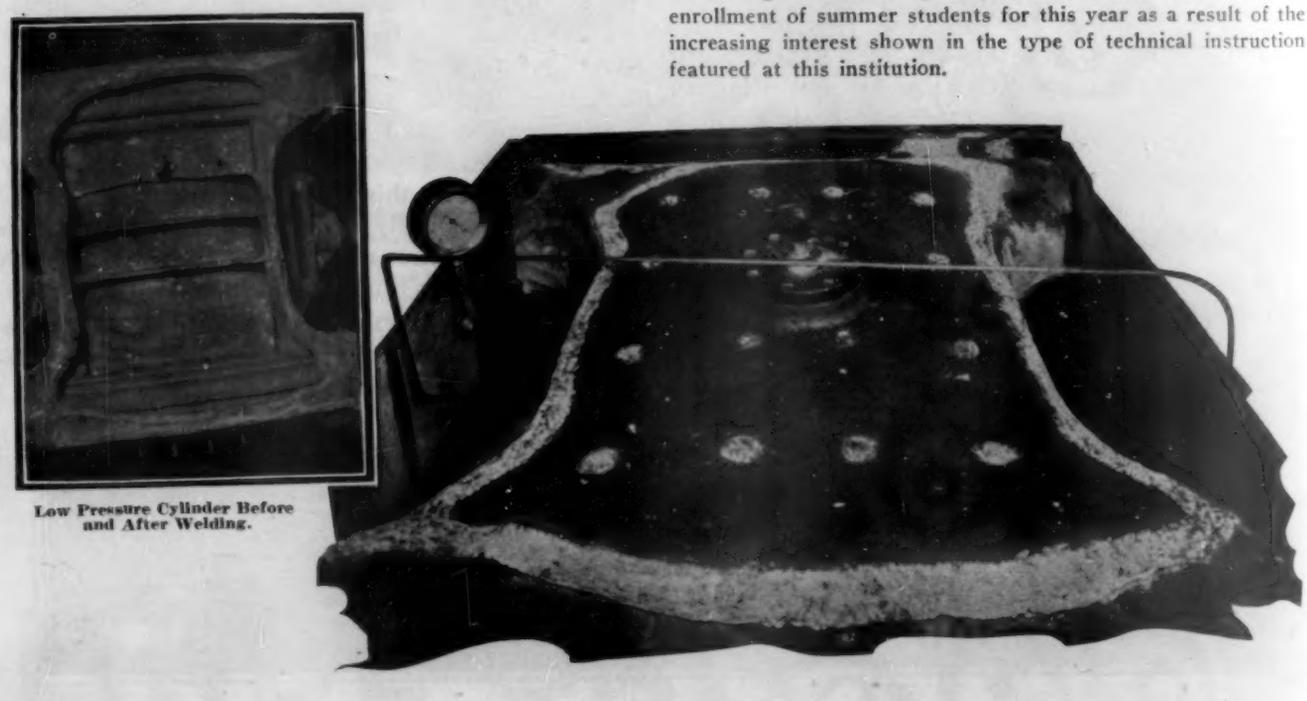
An insurance inspector who has had considerable experience with arc welding, had the courage to order this repair by that process. He turned to the Electric Arc Cutting & Welding Company, makers of arc welding apparatus and rented two alternarc machines together with operators. The complete top of the cylinder was welded in between Friday morning, March 26th and Sunday afternoon, March 28th, and the engine was put back in operation Monday morning at 7 A. M.

The photograph shows the entire patch, which measured 42x62 inches with irregular contour. A special casting had to be made from a pattern fitted into the break itself, the casting being different and the outer edge of the break being chipped so as to form the necessary bevel to weld clear through. The casting was made of steel and stay-bolted securely by ⅛ in. rods welded into its top surface with the proper bevel and the cast iron break was studded with steel all the way around. Cracks emanating from the break were studded and welded. The entire job was caulked to relieve the strains and close possible porosity on the edge of the cast iron. When the test was applied several leaks were located at the cast iron job and stopped by caulking, as well as two leaks in the patched casting itself, probably due to the speed with which this casting was made. These leaks were cut out and rewelded and the engine is in service the same as before the accident, with considerable saving in time, money, not to mention loss to the community by shutting down of the plant, etc.

CARNEGIE SUMMER COURSES

Excepting a few guest instructors and special lecturers, none but members of the regular college teaching staff has been appointed to the faculty for the summer courses this year at the Carnegie Institute of Technology, according to an announcement from the Pittsburgh institution. The guest members of the faculty, it is further announced, will be on duty at various periods during the six weeks' courses for teachers from June 28 to August 6 in the College of Fine Arts. For the eight weeks' courses from June 4 to August 6 for undergraduates in the industrial and engineering courses, only members of the regular college faculty have been engaged.

Carnegie officials report plans to receive another large enrollment of summer students for this year as a result of the increasing interest shown in the type of technical instruction featured at this institution.



Low Pressure Cylinder Before and After Welding.

An Unfinished Test

The Strength of a Bronze Joint in Eighteen Inch Cast Iron Pipe Has Not Been Determined, But the Joint Is Performing Successfully

SPECIAL applications of the Oxy-acetylene welding process are not limited to any one operation, to any single size, or to a particular industry, but with slight modifications these special jobs can be put into service in a great variety of shapes and sizes, and sometimes into a number of several widely different industries. This is the theory on which expectations for expansion of the industry is founded, and in this era of progress the theory is a sound one. In practice we find that it works. It worked at the very beginning of the industry, when many enthusiasts attempted jobs which were not impossible, but for which fundamental engineering data were not available, and made failures. The inherent merits of the process were too valuable to industry to allow of their being overshadowed by criticisms resulting from such failures, so faults were located and corrected. Methods of operation were perfected with experience, until results were secured which guaranteed satisfaction with the process, and its acceptance by industrial engineers.

Above—Bronze Welded Pipe on Line-up Rack

Left—Sinking the Cast Iron Pipe Into the Well

(Photos by Courtesy of the Linde Air Products Co.)

Cast iron brazing, or bronze welding on cast iron, has been growing in popularity for a number of years. Following its use for repair work came experiments and finally field applications of the process to production work. Gas companies have used the bronze collar joint on cast iron pipe lines, and are still working to develop further savings and advantages from the use of the process in this construction.

The success of the bronze welded joint in this field attracted the attention of S. B. Geiger, an artesian well contractor, located at 37 West Van Buren Street, Chicago. There were obvious advantages in the use of cast iron pipe for the casings of artesian wells, the principal one being that the life of such casings is probably three times that of a steel casing. The objection to the cast iron pipe casing is the size and clumsiness of the old fashioned type of joints. Older forms of joints are more bulky, and consequently require the drilling of larger holes than are needed for a welded joint, an item which makes a huge difference in the cost of drilling a deep well.

Continued interest in the possibility of making a better well by the new process led the well contractor to consult L. M. Malcher, President, Chicago Oxy-Welding Corporation, 2613 South State Street, Chicago. Could he furnish a joint on cast iron pipe which would not increase the diameter of the casing more than 3/8-inch? And would it be strong enough so that the top joint would hold the dead weight of the rest of the casing?

Mr. Malcher knew he could furnish men to make as good a joint as could be made, but had no data to show just how good that joint would be. He saw, however, that if one job of this kind were successfully completed another new field for the bronze weld would rapidly develop. He talked it over with engineers of one of the large manufacturers and secured their co-operation in carrying out a test for the benefit of Mr. Geiger.

Two short lengths of eighteen inch cast iron pipe were butted together and welded with the bronze collar type of weld that is used in gas main work, forming the test piece shown in the accompanying photograph. Bronze reinforcing bands were applied outside the holes bored for the bolts against which the pull was to be applied. These were only for the purpose of making the pipe break between the pulling bolts.

On the first test in the testing laboratory the testing apparatus broke down at 22 tons. Another rigging was secured, and this time the apparatus lasted until the pull was 37 tons. The bronze joint had showed no sign of distress, but the machine was getting discouraged. Finally the rigging shown in the photograph was devised. One and one-half inch plate, 4 inch by 4 inch bars, and one and one-half inch bolts were the materials used. Now they were ready for a strong pull, and they went to it. As the tension increased the heavy steel plates finally began to buckle, and the bolts began to stretch. One of the bolts gave way at 84 tons, and the pipe and its welded joint were still unaffected.

By this time Mr. Geiger had seen enough. He declared that the joint was two or three times as strong as it needed to be, and that if that kind of workmanship could be assured on a field job he would try it out on one job. Perhaps some day this joint will be pulled to its breaking strength. Experiments so far made with it have proven conclusively that it fills the bill for artesian well casings.

Work was started on the first casing of this type at Monmouth, Illinois. Mr. Malcher felt the responsibility of this pioneer work and was careful to use the best of materials and operators who were known to be skillful. There was no skimping. It turned out that the well crew, unaccustomed to the new form of work, were responsible for numerous delays at first, so it took a little experience to organize the work so as to secure the most efficient operation. The program which worked best was to weld two lengths of pipe together in a

horizontal rack, then make a weld with the double pipe length in place over the preceding length. When welds were made with the pipe in a vertical position a steel band was applied to the cast iron pipe just below the joint to act as a form or shelf for the collar of bronze.

This first well casing, containing 51 lengths of 18-inch cast iron pipe, was finished a year and a half ago. It shows every

This Joint Took 84 Tons Pull Without Breaking

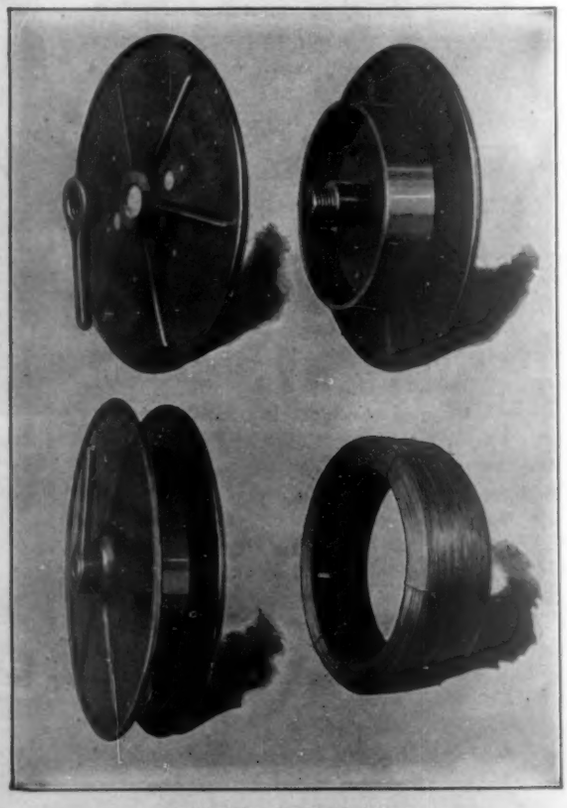
sign of being a perfectly satisfactory job, and the same contractor has sunk two more since that time, to show his confidence in the bronze welded joints for cast iron well casings. Experience gained on the first well paved the way for economies on the later jobs. Some experience was also gained on the later jobs which proved that work of such an important nature requires expert operators. Bronze welding has its peculiarities, and allowance must be made for them. Jobs like the one described can be done successfully if the men are properly trained for it.

E. G. LUENING LEAVES CHICAGO AND JOINS KENTUCKY OXYGEN COMPANY

Announcement was received in Chicago about the 24th of April that Mr. E. G. Luening, who has been known for a good many years as a consulting engineer in the oxygen producing industry, had relinquished his consulting practice and accepted a position with the Kentucky Oxygen-Hydrogen Company, of Louisville, Kentucky. Several of Mr. Luening's friends in Chicago immediately got together and made plans to give him a farewell dinner and a token of their appreciation of the splendid work which he has done in the oxygen industry. The dinner was held April 27th in the Radio Room of the Rainbo Gardens, in Chicago, and was attended by about thirty-five of Mr. Luening's friends, many of whom came from out of town in order to be at the dinner. Mr. Luening has been intimately connected with the oxygen industry almost from its beginning. His services as consulting engineer have been in demand by oxygen plants in every part of the country and he has gained a number of friends and admirers by his unselfish devotion to the task of giving them the sort of service which they required. All those who attended the dinner were glad of an opportunity to express their appreciation of the work he had done for the industry and the fine spirit which had been behind it. There were also a number from out of town who were not able to reach Chicago in time for the dinner but expressed similar sentiment by means of telegrams and letters. At the close of the dinner Mr. M. Keith Dunham, acting as chairman of the group, presented to Mr. Luening, in behalf of his friends and associates, a gift consisting of a beautiful gold watch and a generous sum of money as an expression of the good will and esteem of all. It was evident in the spirit of the party that all of those who have become acquainted with Mr. Luening have a high regard for the work which he has done and wish for him a full share of happiness and success in his new connection.

HOLDER FOR REELED WIRE

The Chicago Steel & Wire Company, Chicago, Ill., some years ago developed a holder for reeled wire for the users of coiled small diameter wires, and have recently adapted the same idea to the construction of a holder of coiled wire used in automatic arc welding. The use of this reel does away with the necessity for returning metal or wooden reels. After



New Holder for Reeled Wire.

equipping each automatic or semi-automatic machine with one of these reels the customer has no more reels to buy and is relieved of the trouble and expense of returning empty reels. Any amount of coiled wire can be kept in stock without the necessity of storing extra spools. The price quoted on the holders is ten dollars each.

Heat Distribution in the Arc

A Study of Heat Distribution Which May Simplify Some of the Common Problems Involved in Metallic Arc Welding

By J. B. Green, M. E.*

THE metallic arc is one of the most difficult things to analyze that man has had reason to investigate. The heat and light are both intense to a degree that is probably not elsewhere approached and, in addition, the continual passage of molten metal makes it practically impossible to hold conditions constant long enough to take very reliable measurements. On this account, the theory in this article has necessarily been worked out by deduction and reasoning by analogy. It rests, of course, on a foundation of facts developed by experiment and experience but no experiment has been performed, and probably never will be, which might directly confirm the theory itself. It is a well known fact that, in a direct current metallic arc, the heat is seldom the same at the positive and negative ends. This is due to the fact that the arc probably represents a double thermocouple. A few words concerning thermocouples will make this clearer.

Description of Thermocouple Action

A thermocouple will be considered as the simple junction of two dissimilar electrical conductors as shown in Fig. 1.

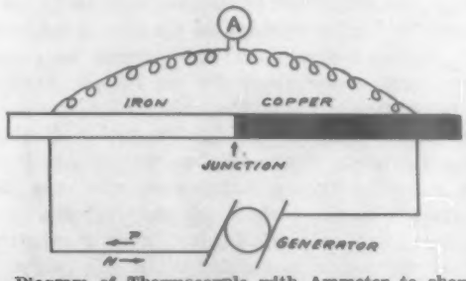


Fig. 1. Diagram of Thermocouple with Ammeter to show effect of heating junction, and Generator for showing effect of passing current in either direction.

This represents a bar of copper joined to a bar of iron. An ammeter, A, is connected to the ends of these bars, current from the generator may be sent through the bars in either direction as shown by the arrows, P and N. If the generator is disconnected, and the junction, J, heated, the ammeter will show an electrical current is flowing, the heat energy having been converted into electrical energy. If the ammeter is now disconnected and the generator connected so that a current flows through the bars, the junction will be heated when the current flows in one direction and cooled when it flows in the other direction. If antimony is substituted for the copper bar, the same effects will be noted but always of the reverse order. Current will flow through the ammeter when the junction is heated but in the reverse direction and the heating and cooling effects will be reversed. Every conductor bears a certain polarity toward every other conductor; that is, it is either positive or negative. Furthermore, the junction of any pair of conductors always produces a definite voltage at the ends of the conductors for a certain temperature. The thermocouple may thus be considered a reversible converting engine changing heat to electricity or electricity to heat. It might also be added that similar effects are produced in a conductor all of the same material between portions at different temperatures. The commercial application of the thermocouple principle most familiar is in the pyrometer for measuring high temperatures. The instrument on which the temperature is read is really only a voltmeter calibrated in temperature which is possible because the voltage from the thermocouple is proportional to the temperature of this couple. Considerable is known about thermocouples where both of the conductors are metals, but practically nothing is yet known where one is a vapor as in the arc. Some of the statements in this article may therefore be subject to correction later.

* *Research Department, Chicago Steel & Wire Company.*

Heat Explained

Before proceeding to show the significance of the thermocouple in connection with the arc, it might be well to consider what is meant by heat. Many are apt to confuse heat with temperature and, if an object is at a higher temperature than our body, we say it is hot and, if a lower, we say it is cold. From this, we jump to the conclusion that cold is the opposite of heat, while it really is only the opposite of hot. Hot and cold are relative terms referring only to temperature. The scientist knows that heat is one form of energy, electricity another, light another, etc. Temperature is a measure of the intensity or, more properly, pressure tending to make heat flow from one place to another. It has the same significance as volts have for electricity. From this, it will be seen that there can be both currents of heat and currents of electricity and that these currents require pressure to flow. The moment it is known that pressure enters the consideration, it must also be realized that all pressure has direction.

Thermocouple Theory of Arc Heat Distribution

Now go back to the idea of the arc being a thermocouple and consider that this is really a means of converting heat to electricity or electricity to heat. When it converts heat into electricity, a direct current is always produced and the direction this current flows depends on the nature of the dissimilar conductors that make up the junction. For any one pair of materials, one will always be positive and the other negative although at times two substances may make up the junction with so nearly the same thermocouple properties that it is almost impossible to detect which is positive and which negative. It then appears as if there were no thermocouple action. In the metallic arc, there are really two thermocouples, one composed of the arc vapor and electrode, the other of the arc vapor and work. Under most conditions with which the welder is familiar, the arc vapor is positive while both the electrode and the work are negative. This means that the thermocouple current flows in the directions shown by the arrows in Fig. 2. The arc being the middle, these directions are opposite. The welding current from the generator flows only in one direction, usually from the work which is thus positive, to the electrode which is negative. This means that the welding current must buck the counterforce of the thermocouple current at the work side and go with it at the electrode side of the arc. There will thus be a voltage loss or drop in the welding current as it passes through the junction of metal and vapor at the work and a gain or rise at the electrode. It follows that there is a loss of electrical energy at the work and a gain at the electrode.

It is a fundamental law of physics that the form of energy may be changed, that is, from electricity to heat or heat to electricity for example, but that energy itself, regardless of its form, can neither be created nor destroyed. The thermocouple being a means of changing the form of energy from electricity to heat or vice versa, it becomes plain that whatever the loss

of electrical energy at the work side junction must represent an equal gain in heat energy at that junction and likewise whatever the gain in electrical energy at the electrode junction must represent an equal loss of heat at that junction.

For practical purposes, it may be considered that heat is liberated at the work and absorbed at the electrode. This conclusion is somewhat different from what most welders have believed to be true. It has been the popular conception that heat is liberated at both the work and the electrode, but apparently this is not so. The heat comes entirely from the junction at the work and the arc itself and enough heat must be supplied by these sources to the electrode to furnish what is absorbed due to the voltage rise of the generator current as well as enough to melt the electrode and vaporize at least some of this material in order to maintain an arc. Before a thorough understanding of the distribution of heat in the arc can be had, it is really necessary to consider what takes place under various conditions.

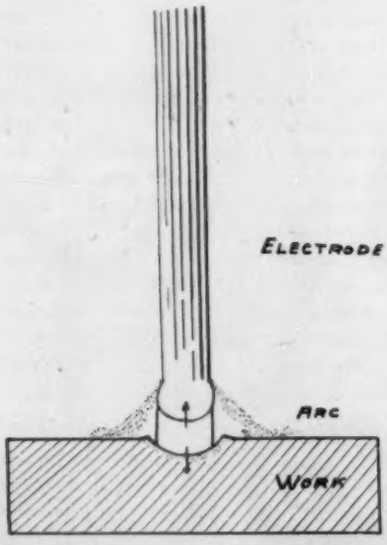


Fig. 2. Diagram of Metallic Arc with arrows indicating most usual directions of back voltage pressure at the two thermojunctions between the molten metal and arc vapor.

Factors Affecting Arc Heat Distribution

It is well to first list the different factors which may be varied and then discuss them one at a time. These may be considered as follows:

1—Arc Length.
2—Arc Vapor Resistance.
3—Polarity of Welding Current.
4—Polarity of Work Thermojunction.
5—Polarity of Electrode Thermojunction.
6—Radiation.

Effect of Arc Length

It can be seen that, the longer the arc the greater the quantity of heat liberated, because the heat developed in the arc stream is due to its resistance. Lengthening the arc stream, however, may throw all sorts of other factors into a new system of relationship which might and, in fact, usually does actually result in reducing the heat. The electrode tip, being farther away from the work, receives less heat from this source which is where most of it would seem to come from when the arc is very short and practically none when it is very long. If the extra heat from the long arc actually compensated for this, there would be no new conditions introduced on this account. Such a state of affairs could probably exist for only one set of conditions and all others must tend toward either more or less heat reaching the electrode. A change of heat means a change of the character of the vapor which, in turn, means not only a change in the resistance of the vapor but the degree of dissimilarity between the metal and vapor forming the thermojunction. All of these changes may be quite minor and almost, if not quite, unnoticeable and then again they may be marked.

Increasing the arc length, however, introduces another phase which generally makes quite a marked change in conditions. The longer the arc, the greater the contact with the air. Both the oxygen and nitrogen of the air are quite active chemically in the arc and at arc temperatures. This not only changes the composition of the arc vapor but also the arc passed metal. One example might be used to show how very marked the effect of oxygen and nitrogen is on arc passed metal. The following analysis is worthy of some study.

	Electrode	Deposit
Carbon	.16	.04
Manganese	.325	.057
Sulphur	.032	.017
Phosphorus	.018	.018
Silicon	.007	.003
Combined Oxygen	Trace	.122
Combined Nitrogen	Trace	.104

This test was made on a piece of mild steel with a bare electrode carrying as heavy a coating of lime as can be applied in the drawing operation. Such surfacing makes for easy manipulation and so a very short arc was held. The deposit was built up vertically and the sample was taken at some distance above the base metal so that this in no way influenced the result. In other words, the analysis of the deposit showed strictly the composition of the arc passed metal.

It will be noted first that twelve points of carbon have been burned out of the electrode. In the arc itself, this, no doubt, became carbon monoxide which, when it escaped from the arc stream, still further oxidized to carbon dioxide. Both of these are gases. Some sulphur was oxidized away, no doubt, in a similar manner but the quantity was, of course, small compared to the carbon. A very substantial quantity of manganese was oxidized, in fact, over a quarter of one per cent of the whole material. While this might to some extent escape as a vapor, the chances are, most of it went into a slag as manganese oxide, some probably going into the weld deposit. The outstanding feature of the deposit analysis is the very large amount of combined oxygen and nitrogen, in each case amounting to more than one-tenth of one per cent. Both of these must surely be present in the weld metal combined with iron or, possibly to a small extent, with manganese. It so happens that the atomic weight of manganese and iron are practically the same, being 55 and 56 respectively. The atomic weight of oxygen is 16 and of nitrogen 14. This means that, if there is one-tenth of one per cent each of combined oxygen and nitrogen in the deposit metal, there is one-half per cent each of the oxides and nitrides or a total of one per cent of the weld metal is represented by these compounds. Both of them are very hard and it is reasonable to suppose that they have a marked influence on the properties of the deposit. It is believed that the above example represents very close to the minimum so far as the presence of oxides and nitrides is concerned in any weld from any rod. Both of these compounds are quite difficult to analyze for and there may be differences of opinion as to how much of them are actually in a deposit, because each chemist thinks he is best able to perform an accurate analysis. The greatest care was used in performing the above analyses, checks being made and furthermore it was not done as ordinary laboratory routine but by a man who stands very high in the chemical profession. The air contact in the arc not only changes the composition of the deposit but also the arc vapor. All this appears quite complicated and, of course, it is, but a consideration of the other factors makes it clearer. Much of the necessity of studying a long arc is eliminated because the experienced,

skillful welder nearly always holds a very short arc and the above analysis is just one concrete reason why this is so necessary.

Effect of Arc Vapor Resistance

Before considering in detail the arc vapor resistance, it might be well to realize where this vapor comes from. To obtain a substantial quantity of vapor, the substances from which it is derived must be heated to their boiling points. As a usual thing so far as the arc is concerned, the boiling point represents a very high temperature. It is difficult to raise the work to such temperatures because it is a good conductor of heat and therefore very little heat pressure or temperature is required to cause the heat to flow away. This is equally true of the electrode but here the heat can only flow through metal in one direction while in the work it not only can flow back from the weld zone but sidewise in all directions. Thus it will be seen that the electrode, regardless of its polarity, offers the greatest possibility of supplying at least most of the arc vapor. A reversal of this could, of course, take place; for example, when the work happens to be a thin galvanized sheet. The thin sheet can not possibly conduct heat away as fast as a heavy plate and then the zinc which forms the galvanizing vaporizes at a relatively low temperature. Then again, the electrode material usually passes through the hot arc in a fairly finely divided state, while the work material does not pass through the arc at all. The finer a given mass of material is subdivided, the greater its surface. Heat may readily enter such material but cannot leave. Hence it is more readily raised to a high temperature. Parenthetically, it might be mentioned here, that all this indicates the welder should lay a great deal of stress on the selection of the proper electrode for each job, even if the job differs only slightly from some other one. Under some conditions, it may be highly advantageous to use a different electrode for the bottom layers than is used for the top layers in multiple layer welding. A moment's thought will show that there is a substantial difference in the conditions surrounding the application of the top and bottom layers. Inasmuch as the arc vapor usually comes essentially from the electrode, the materials of this electrode govern the vapor resistance. The electrode materials include what is on the surface as well as what is in the rod. Often materials on the surface in such small quantities they can hardly be detected by the welder have a greater significance than the materials of the electrode.

What might be called the electrical nature of these materials should be understood. Scientists call metals "Conductors of the First Class" and the materials on the surface "Conductors of the Second Class." These surface materials might sometimes be said to be metallic in nature but they are not actually metals. It must not be imagined that second class conductors are such because in the case of welding rod they happen to be found on the surface. All materials as lime, porcelain, etc., usually called insulators are second class conductors. The reason they are generally looked on as insulators is because, at ordinary temperatures, it is practically impossible to make electricity flow through them. The scientist calls them conductors because he does not recognize any one particular temperature and he knows that at high temperatures they become very good conductors. On the other hand, the higher the temperature of a first class conductor, the greater its electrical resistance. How much of the total heat is liberated in the arc stream itself depends, of course, on the resistance of the arc vapor as well as the length of this vapor stream. As most of the total heat seems to be liberated here, it is quite important to know what influences the resistance of the arc vapor and how.

Effect of Polarity of Welding Current

Taking up now the polarity of the welding current as it influences the distribution of heat in the arc, leads to other considerations. The thermocouple effect is just reversed if the electrode is made positive or opposite to what welders call regular polarity. Consider what this means in the case of flat welding and it will then be easy to modify this for other positions. Heat is liberated at the electrode junction and absorbed at the work junction. As already explained, the electrode carries heat away slowly while the work usually carries it away quickly. Convection currents carry the arc vapor up and away from the work or to use a more common expression, heat rises. Under such conditions, it could become practically impossible to keep any appreciable amount of metal molten on the work and the arc vapor probably tends to condense quickly near the work causing the arc to break and go out. The excessive amount of heat at the electrode raises the temperature here usually resulting in increasing the violence of the chemical action of the air, and the arc can thus become so wild that the metal leaves the electrode in large enough globules to completely span the arc length, causing a freeze. All these conditions are tendencies. Just what actually happens depends on the relative intensity of the factors involved. For instance, the electrode may be coated with a second class conductor producing a vapor of such extremely low resistance that only a trace of it is required to carry the current through the arc. There will be far less tendency for such an arc to go out on reversed poplarity. Then again, this vapor may be of such a nature that it prevents the air from causing violent chemical action and so the electrode will not tend to freeze. A moment's thought will indicate what effect position has here so it will not be discussed.

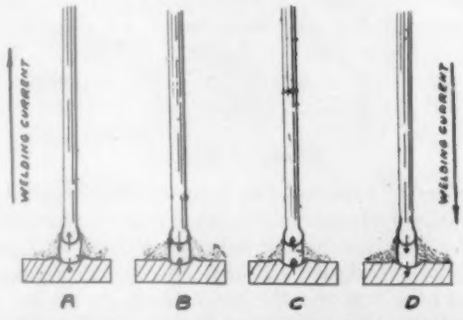


Fig. 3. Diagram showing by arrows the possible direction combinations of thermojunction back voltage pressure in the metallic arc.

The amount of back voltage pressure must be considered due to the thermocouples. If an arc could be imagined with no such back pressure, it should show the same characteristics on direct current as the welder is ordinarily accustomed to in the alternating current arc, providing, of course, the frequency of alternation is sufficiently high. The effects just noted would all be minimized to this point but not to the point the welder expects with regular polarity and direct current. Should the back voltage pressure due to the thermocouples be excessive, these effects will be accentuated in proportion.

Effect of Thermocouple Polarity

Following the effect of welding current polarity is that of the thermocouples and it might be well to treat this for both the electrode and the work together. This polarity must be either vapor to metal or metal to vapor but it is conceivable that it might be one at the electrode and the other at the work. This would permit the following combinations:

A—Vapor to metal at both electrode and work.
B—Metal to vapor at both electrode and work.
C—Vapor to metal at electrode and reverse at work.
D—Metal to vapor at electrode and reverse at work.

When the polarity of the welding current is also taken into account, this doubles the number of combinations, making

eight in all. The diagram in Fig. 3 indicates this. But one series is drawn and the welding current is shown going in both directions.

It is quite fortunate for the welder that he is not apt to meet all of these eight combinations in his daily work. Seldom is anything encountered other than vapor to metal with the welding current polarity work to electrode. Only rarely can the existence of the combination metal to vapor be positively identified and when this exists, it is usually better to reverse the welding current polarity for the sake of arc stability. It is doubtful that this combination is found sufficiently pronounced to definitely identify it without the aid of the arcometer, a laboratory instrument developed by the Research Department of the Chicago Steel & Wire Company for determining the properties of electrodes. When this combination is approached, some welders feel they are better off by reversing the welding current polarity but this is of doubtful benefit. So far, the Research Department has never been able to identify either of the thermocouple combinations where the polarity is opposite at the work and the electrode. There seems to be a reason why this cannot exist under ordinary welding conditions. At least a fair proportion and probably a major proportion of the surface of the molten metal forming a thermojunction on the work side comes from the electrode. On this account, there is a small chance that it can differ greatly from the surface of the molten metal at the electrode junction. Thus, if the molten surface at the work and electrode are substantially the same, they must be substantially dissimilar to the arc vapor surface at both thermojunctions. When such dissimilarity is substantially zero, the back thermocouple pressure not only must be in the same direction but also substantially equal in intensity. There is, however, a greater possibility of a variation in the intensity than in the direction of the thermocouple's electrical pressure.

Effect of Radiation

The effect of radiation has been touched on either directly or indirectly in discussing the other phases affecting heat distribution. Air is a poor conductor of heat as compared to metals, consequently the electrode and the work play the most important part here and the latter is usually far the more important of the two. After what has already been said, the effect of thickness of the work and position during welding is almost self evident, so there is no reason to discuss further.

Conclusions

Whenever a new theory is presented, the question is generally asked, "How can it be used?" There does not seem to be any single outstanding use for this theory of Arc Heat Dsitribution. Rather it has a thousand minor uses. The old saying "Knowledge is Power" is usually true and the welding supervisior or welder who fully understands this theory will find himself unconsciously understanding problems which come up from day to day that formerly were mysteries. It almost goes without saying, that the less mystery there is concerning welding, the better the art can be practiced. The author has learned to think in terms of Arc Heat Distribution and, when this is done, it is often surprising how easy it is to answer many questions quickly and correctly which would otherwise be completely baffling. A few such questions are those concerning selection of suitable electrodes for various thicknesses of material to be welded, desirability of reversing polarity, and the like. Months of study have been required to develop this theory of Arc Heat Distribution so the reader must not expect to glance through the article and grasp its full significance immediately. To do any good, the man on the job or the man over the job must know this theory. It is presented here in plain, non-technical language so that any welder who wants to put enough time on it can completely master the subject.

(NOTE—This is one of a series of articles by Mr. Green in which the welding qualities of electric and gas welding rods will be discussed. The observations made and conclusions drawn are the result of a long series of experiments but it is recognized that other investigators may have formed different conclusions as a result of experiments made in other ways. Correspondence is therefore invited on the subjects covered, in order that any errors made in conclusions may be corrected and any data which serves to confirm the conclusions given will also be welcomed. It is felt that much good will result from a thorough discussion of the different characteristics of welding rods and wire.—Editor.)

APRIL MEETING OF LOS ANGELES SECTION

The Los Angeles Section of the American Welding Society held its regular April meeting in the Auditorium of the Los Angeles Creamery on Thursday night, April 29. The meeting was well attended and was presided over by L. G. Hicks, chairman.

W. F. Stoody, of the Stoody Company, Whittier, Calif., was the first speaker on the regular program. He gave an interesting talk on the important part welding was playing in the building up of drilling bits for the oil industry. He illustrated his talk by showing a varied assortment of drilling bits, told how each was built up by welding hard steel onto manganese steel or high carbon steel. Also he had an estimate of costs compiled by an eastern concern dealing with the comparison between the cost of drawing a fish tail bit out under the hammer and that of building the same bit up by welding, in which the cost of the latter was shown to be initially higher, but which was reduced to relatively the same amount because of the greater life of the welded bit. These figures, the speaker said, were not conclusive, since they had to do with but a single case of comparison. However, he drew the inference from this example that in the long run the cost of building up bits by welding would be less than that incurred in drawing them out under the hammer.

Chester Mott, of the Purox Company, manufacturers of welding and cutting apparatus and supplies, gave the welders some good advice in his short address on "The Use and Care of Equipment."

The speaker said that good welding displayed four characteristic factors. These were: economy, despatch, workmanship and safety. He said he intended to make a plea in behalf of the manufacturers of welding equipment to the effect that the journeyman welder give his equipment better and more careful treatment. He said that too often the manufacturer finds welding equipment in a most deplorable condition with its owner apparently indifferent to this fact. He asserted positively that the loss due to bad conditioned equipment reduces the economy in its use by from 20 to 80 per cent. Upon the contrary, if the owner would employ a service man to see that his equipment was kept in the pink of condition this loss easily might be reduced by 50 per cent.

Mott disclaimed any intention upon the part of manufacturers to secure the job of servicing equipment, but said they were far more directly interested in the preservation of the efficiency of equipment than they were in putting it back into efficient form after it had deteriorated. He advised his hearers to detail some man in their employ whose duty it should be to see that all equipment was kept in good order and then to hold him responsible for the faithful performance of that duty. Such a man need not be so skilled as to be a welding inspector, but he should be skilled in equipment inspection. Any welder who desired to do so could get all the information necessary regarding the care of his equipment from any manufacturer.

Secretary Ardouin announced before adjournment that a joint meeting of the Los Angeles Section of the American Welding Society and of the Los Angeles Section of the Society for Steel Treating was being arranged for sometime about May 15.

Cutting Cast Iron With the Torch*

The Development of a Special Torch Which Provides for Preheating of the Cutting Jet of Oxygen

CAST iron is an alloy consisting essentially of iron and carbon, the percentage of carbon varying between 2.5 and 5.0 per cent. The carbon is usually in the free or graphitic state and is mixed with the iron in the form of flakes. It is the presence of these that the arrest of the propagation of the combustion of the metal in contact with oxygen is often attributed. In addition, it is invariably admitted that the principal obstacle to the cutting of cast iron is the fact that the melting point (2,000 deg. to 2,000 deg. Fah.) is distinctly lower than that of the oxide (2,450 deg. Fah.).

In spite of the existence of these factors practical tests which have been carried out in France and America have proved that, by various artifices, it is possible to divide cast iron by a jet of oxygen, although the "cuts" obtained are not to be compared with those obtained on steel at the present time.

In the first place the process as used in France since 1912 for the destruction of cast iron is worth noting. The cutting blowpipe consists of an iron or steel tube into which is placed a bundle of iron wire. The tube is connected to an oxygen cylinder equipped with a regulator capable of supplying a large volume of gas. The point where the cut is to commence and the end of the tube are raised to a red heat and the oxygen is then turned on. The tube in the process of combustion is applied to the heated point of the work and the heat of combustion of the iron burning in oxygen supplies the heat which raises the cast iron to the melting temperature. The process is therefore not cutting as is generally understood but a perforation of molten metal.

In America the work done by the first experimenters on cutting cast iron with the blowpipe has proved sufficiently valuable to form the starting point of cutting methods which are now in actual use. Having discovered that additional heat is necessary, they have reached the conclusion that this can be obtained by heating the cutting oxygen. In practice, to obtain this result, they used an abnormal flame by introducing an excess of acetylene; the white cone of the flame becomes much longer (1 to 2 inches), the jet of oxygen in traversing it reaches the cast iron to be cut at a much higher temperature. Further, it is recommended that the tip of the blowpipe be given a spiral motion so as to widen the cutting groove, called the kerf, and allow the flame free access to the metal. This method of cutting gives interesting results which have appeared from time to time in technical journals. Photographs of large cast iron wheels, casting, etc., cut into suitable sizes for remelting in the foundry have formed the general run of cast iron cutting. As a result of this development special nozzles for fitting to the ordinary cutting blowpipe and which give the necessary excess of acetylene without the necessity of increasing the acetylene pressure, the acetylene apparently being obtained from cylinders of dissolved acetylene, are used.

As to the theories which have been put forward to explain the above results, and the phenomena produced during the cutting of cast iron, they are, in our opinion, not satisfactory. We are not stating this in the spirit of criticism, because we know, from experience, how unsubstantial is the basis on which explanations on this subject are made. The presence of graphite does not, for example, constitute a real obstacle, because at a temperature of about 1,500 deg. Fah., the carbon is in solution in the iron and consequently the jet of oxygen is not in operation in the presence of graphite. The brilliant spots that are observed under the flame and which are frequently taken for graphite can be shown to be particles of oxide produced by the local heating. As regards the theory relating to the melting point of the oxide it is sufficient to note that to commence a cut on cast iron it is necessary to heat it above its melting point.

The experiments that have been made in the laboratories at the headquarters of the French Welding Association, over many years, have confirmed if not explained, at least the practical conclusion reached in America, namely, that in order to cut cast iron the cutting oxygen should be heated to a high temperature. These experiments have been made by means of a cutting blowpipe with a separate jet of oxygen. The cutting oxygen is made to pass through a coil raised to a very high temperature by means of a powerful welding blowpipe. With these conditions the starting of the cut and the cutting progress itself is good and rapid. The introduction of a slight excess of acetylene into the heating flame improves the results, but in order to avoid bridging in the cut it is necessary to give the blowpipe a circular or zig-zag movement similar to that used by the Americans. This improvement is not

Fig. 1

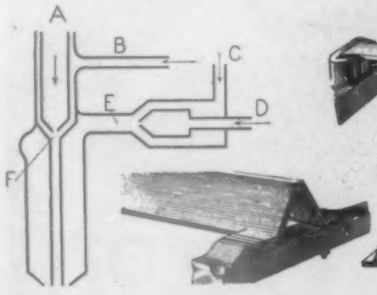


Fig. 3

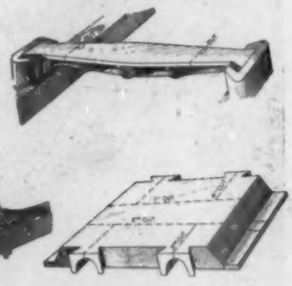


Fig. 4

Fig. 2

due to the oxygen passing through a cone of greater length but to the fact that the combustion of a portion of the excess acetylene takes place by contact with the outer surface of the cutting jet of oxygen, supplying the latter with an appreciable quantity of additional heat and advantageously heating the metal.

Inspired by the work that has been done in America and Europe, La Soudure Autogene Francaise have continued their researches into the cutting of cast iron with a jet of oxygen. Numerous and varied tests have led them to modify not the heating flame but the cutting jet, into which a certain quantity of acetylene is introduced.

This Company has designed a low pressure cast iron cutting blowpipe in which the cutting oxygen aspirates, in the blowpipe itself, the quantity of acetylene necessary and sufficient for the complete success of the operation.

The diagram, Fig. 1, shows in diagrammatic form the principle on which the apparatus works. Oxygen for cutting enters at A and oxygen for heating at D. Acetylene for the heating flame enters at C and for the cutting jet at B. E and F are mixing chambers for the gases. It is clear that the heating flame is produced under the usual conditions, and that at the orifice of the cutting oxygen an additional quantity of acetylene will escape. The latter burns instantly on its exit and considerably increases the temperature of the oxygen. The small quantity of impurity that is formed by this reaction has no effect on the cutting operation.

The first tests with this blowpipe gave results which were absolutely new, that is, as far as the cutting of cast iron is concerned. Compared with the results hitherto obtained, the speed of cutting is much greater, the groove or kerf is much narrower and the faces of the cuts smoother and comparable to good cuts made on steel. In fact, the blowpipe is advanced in a straight line, in other words, no circular or other movement is necessary and consequently a cutting guide can be used to obtain accurate cuts. The gas consumption measured on the basis of gas consumed per

*From Revue de la Soudure Autogene, Translated by Capt. D. Richardson.

square inch of cut is greater than that required for cutting steel.

This blowpipe will have a wide field of application, as it can be used not only for simple demolition work on cast iron but also in production work for modifying, repairing, etc., castings. It has been used with great success in extensive alterations to a railway bridge over the Rhone at Lyon-Perrache. The following are details of these cutting operations:

The bridge consisted of five arches, each arch comprising 32 cast iron stays of the form shown in Fig. 2, 92 stays of the T form shown in Fig. 3 and a number of stays of V form as shown in Fig. 4. Owing to increasing and heavier traffic and signs of weakening due to age the question of reinforcement and replacement of condemned portions became urgent. All operations, such as hammering, etc., likely to cause shocks was prohibited and the

Fig. 5

removal of the castings under these conditions limited the methods to drilling, which would involve an enormous time, or cutting by means of a blowpipe. Fortunately at this period the Autogene Francaise Co. had completed their tests with the blowpipe described and the Railway Company having decided to adopt the second method an excellent opportunity for demonstrating the qualities of the new blowpipe was presented.

The cuts made by the blowpipe are shown in the diagrams. In Fig. 2 the dimensions of the castings are approximately 4 ft. 6 in. by 4 ft. 3 in. and 1 inch in thickness. The necessity of making the cuts in the manner indicated is due to the weight of the castings and their safe removal. In Fig. 3 the operation consists in first removing the cement and iron wedges which cannot be removed with the ordinary welding or cutting blowpipe. By means of the new blowpipe the refractory cement is easily destroyed and at the same time the iron wedges embedded in the mass are burned out.

The removal of the V stays, shown in Fig. 4, proved comparatively easy. Fig. 5 shows the operator in the process of cutting one of the stays and one of the cuts just previously made. An examination of the latter shows that in spite of the operator not using a guide the cut is clean and narrow. It is interesting to note that the operator had practically no previous experience on this class of work.

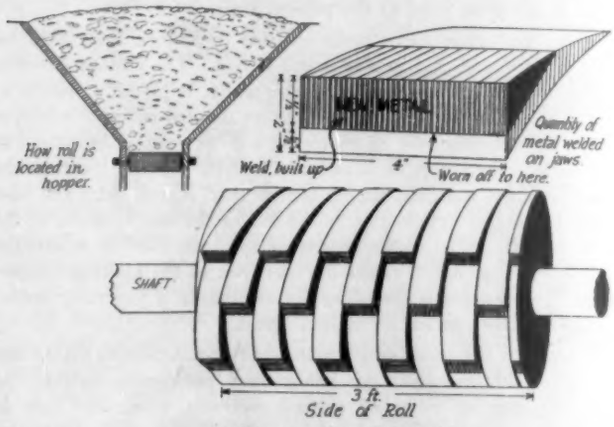
From an industrial aspect no better method of demonstrating the value of this new type of blowpipe could have been desired. The field for cast iron cutting with a blowpipe constructed on these lines is very extensive and there is no doubt that the process will rapidly expand as its merits become known.

TERRA COTTA AND BRICK FACTORY REPAIRS BY WELDING

By J. H. Ady

Some time ago I was called to a terra cotta factory, where terra cotta pipe is manufactured. Upon my arrival the manager stated that they had a welding job for me. He sent me out to the mill room with the superintendent, and we looked over the job. It was on a crusher roller, which is used to crush a lot of materials, such as lumps of fire-clay, some of these lumps weighing from 40 to 75 pounds. They are fresh from the mine and as hard as flint. The roll is located in a large hopper, the jaws protruding from 2 to 4 inches, and taper down to nothing at the body of the roller. The illustration explains just how this piece of work was done.

The jaws were worn down so low that the machine would not operate unless the operator used an iron bar and a sledge hammer to break up the lumps. This necessitated the shutting down of the machine, and cost a great deal in time and money. The superintendent wanted me to weld pieces of car axles where the jaws were worn down, but I convinced him that I could build up the jaws as good as new without removing the roll from the hopper, and with the minimum delay.



Building up of Crusher Roller

There are 36 to 40 jaws on these rolls, and I arranged to do the work in the evenings, figuring that I could weld three or four each time until the job was completed. An oxy-acetylene outfit was used. After I had welded one row across the roll I was congratulated, for when they dumped in a carload of fire-clay the next day, it went through the machine without clogging up once, and the superintendent was very glad, because, he explained, it would take over a week to install a new roll, while the loss of shutting down would mean several hundred dollars, as it was a busy season.

The roll was made of a low grade of manganese, so I used a high grade of welding wire with such good results that the roll lasted almost twice as long as a new one. This was due to the high grade of manganese filler rod. As long as the roll remains in good condition it will always be possible to build up the jaws, and in this way save a great deal of time and money. The repairs in this instance cost less than 30 per cent of the cost of a new roll, and the company was so satisfied with the work that they have given me similar jobs in their other factories.

FINISHING BRONZE WELDS

Many firms who have used bronze welding on production work have found the portable grinder a useful tool for removing the slight deposit which is left on the surface of the metal and which, if not removed, will make it difficult to apply the desired finish. It has been found that the life of the grinding wheel is much longer when used on the brazed work because the metal deposited is comparatively soft. It is also known to a good many shops that a portable grinder is a very quick method of getting a good smooth finish on the completed joint.

Welding Copper Fireboxes

Oxy-Acetylene Process Used for Repair of Practically All Defects—Many Welds May Be Made in Place

By Harold Young*

(Note—The following article deals principally with the welding of copper locomotive fireboxes, which are practically unknown in the United States. It contains considerable material of general interest, however, and will undoubtedly give the reader some new ideas.)

THE repair of defective copper fireboxes by oxy-acetylene welding has occupied the attention of the writer for a number of years. Numerous experiments proved conclusively that the oxy-acetylene welding process intelligently applied could effectively repair practically all defects, cracks, broken tube bridges, etc. "in situ."

A careful study was made of all obtainable writings on the subject of copper welding including British and American Journals. The writer has however to acknowledge that most of the information contained in this paper is to be found in articles prepared by Government and Building Councillor Weese, Central Railway Workshops at Magdenburg, Buckan, and Chief Railway Engineer Adolf Bothe, Railway Shops, Grunewald.

It is proposed to give a description of the apparatus, material used, method adopted and organization required.

Oxygen is obtained in cylinders at a pressure of 150 atmospheres which by means of a reducing valve can be dropped to from 5 to 3 atmospheres.

Portable acetylene plants are undesirable mainly for the reason that interruptions of supply lead to defective welding, hence a large stationary generator should be used and the gas piped to the job. The size recommended has a capacity of 400 lbs. of calcium carbide. A second generator is held in readiness for emergency. The torches used are of the high pressure type, with interchangeable burner tips.

For welding, a rod of Canzler wire 5 to 6 m.m. thick is used. This wire consists of an alloy of copper, phosphorous and silver, and is protected by patent No. 284840.

Canzler wire costs considerably more than common copper wire, nevertheless it is far better to use the special alloy, for, if properly used, the weld is always successful.

During the process of welding, the Canzler copper, like silver solder, remains evenly liquid, even if it is kept liquid for some time by means of the torch and is exposed to the oxygen in the air. As soon as it soldifies however, and is compressed by pounding with a convex faced hammer, it assumes almost completely the characteristics of rolled copper and consequently can be forged in a heated condition. A welded seam produced in this manner, shows a salmon red surface at rupture, no pin holes being visible. Another advantage of the Canzler wire is that it may be applied in a thick layer on a vertical wall sheet, and not the least amount of material will drip down. The surface of the wall remains clean and smooth.

Unskilled handling of the welding torch may cause burning of the weld. Great care should be taken that the oxygen core of the flame does not make contact with the welding rod, or piece to be welded, otherwise the free oxygen present in the flame will combine with the copper, and form cuprous oxide. Oxygen and acetylene should be fed to the torch in the right proportions. The luminous core should not be veiled, but must have sharp outlines.

As copper is a good conductor of heat, two welding torches are required simultaneously, and efforts should be made to approach with them from both sides of the copper plate, in the case of firebox sheets through wall stay holes, etc.

As the welding process must not be interrupted for any length of time, in the case of long welds a third man as relief should be employed, in order not to expose the welder to the high temperature too long.

When welding on both sides, the weld is chiselled out in the shape of an X as shown on Figure 1.

Firstly, care should be taken by liquifying the metal at the bottom to prevent the formation of a hollow space, and new material from rod and wire applied in larger amount than required, as shown Figure 1. On the completion of a stretch 10 to 15 c.m. long, the raised seam is worked flush with convex faced hammers to increase tensile strength of added metal. The hammers weigh about one pound.

It is immaterial whether the seam is vertical or horizontal. In the vertical seam, the welding is started at the lower end, and the torch is held at a suitable angle so that the pressure of the flame tends to prevent liquid material from flowing downward.

All welding should be done speedily, in order not to overheat the adjoining parts, and in this way produce considerable changes in stresses.

If the caulking edge of any plate is corroded, or wasted away, this is repaired by welding on to it new material from the wire. It will be necessary to remove a few rivets, but it is not necessary to chip the edge to obtain a metallically clean surface, as the impurities disappear during welding operations. If, however, the plate is thin and there are cracks between rivet holes the damaged plate is removed by chiselling it off, and a new piece inserted, as shown on Figure 2.

This patch as well as the flange, is cut obliquely and the patch is so inserted, that at Point A, an air space of about 3 m.m. remains between edge of the flange and the patch; the slit increasing upwardly at the rate of about 25 m.m. in a length of 1 m. The patch is held by butt straps sufficiently loose to allow shifting of the patch.

The welding is started in the corner, A, the vertical seam being completed first. On the inside the weld is heated through stay bolt holes. When the vertical seam has completely cooled off, the horizontal seams are welded.

Should small leaks develop during boiler hydraulic test they can be stopped by caulking.

In the case of firehole or copper tubeplates, an angle patch is welded in, as shown in Figure 3. Where a fracture develops in the radius of flange as shown in Figure 4, and the flanges are in good condition the fracture may be welded after the rivets in the flange have been knocked out to permit of free expansion; the reverse side is heated by inserting the welding torch through wall stay holes or washing plug holes and the welding proper is done on the inside, beginning at the bottom, after fracture has been prepared by chipping a 90° Vee.

As a result of the welding, the flange will be open at the joints, and must be hammered into position again as soon as it passes the red hot condition in cooling.

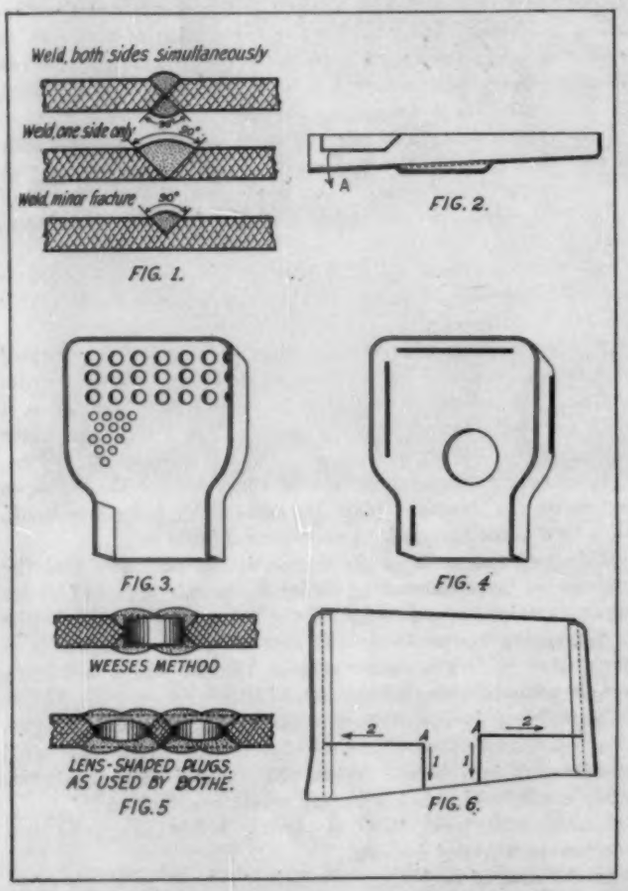
In the case of cracks in tube plate flanges, and in the radius of plate, sufficient tubes may be removed to enable the welders to get at it from the inside of the boiler barrel and then to weld from both sides.

*Designing Engineer, New South Wales Railways.

Councillor Weese says that such vertical and horizontal cracks have been welded in Magdenburg Buckan in 86 tube and firehole copper plates, mounted in fireboxes and that a removal of the boilers from the frame is thereby not required.

The method of welding the broken bridges of a tube plate is exactly the same, in many respects, as that adopted by the writer in his experiments, excepting that the European Engineers have succeeded in doing these "in situ."

Plugs, machined from copper bar, are driven into the tube holes to be dealt with in the manner shown in sketch Figure 5. The tube plate is 1 in. thick and the plug ⅛ in. long, the edge of the hole is cut to an angle of 45° in both sides, so that the plug is in contact about ⅛ in. wide all round. Similarly, the crack between the tube holes is chipped out to 45° on both sides of the copper plate, the material is melted around the plug where it contacts with the tube plate, so that a complete union between the plug and tube plate is obtained, and then the crack is filled up. The welding is done simultaneously on both sides. The time taken to weld plug and adjoining crack, is about 7 minutes. The weld is hammered in the manner referred to elsewhere, then the second hole is welded and so



on; rivets in this case do not require to be removed from the flange joint.

After cooling, the tube holes are drilled, and tubes inserted and expanded.

It is stated that 36 tube plates having a greater number of cracks, have been dealt with without removing the boilers from the frames; the same procedure is followed when the tube holes become too large and the bridge too narrow.

Patches are welded in the manner indicated on Figure 6. The welding is commenced at point A, the vertical seam being welded first, all rivets are removed from the foundation bar where required. For a seam of 1 m. an opening of 12 m.m. is required. This opening closes as the welding progresses. The outside operator heats the plate by threading his torch through stay holes in company with the inside welder. On completion of the vertical seam the horizontal seam is welded, commencing from A. The movement of the patch plate enables the welder to decide what action he should take to make a satisfactory job.

This method of welding patches has only been done in the horizontal position, and the welding only on one side. There are practical difficulties which prevent hammering.

Chief Engineer Bothe states, that when dealing with Canzler wire, two torches, No. 5 size, with a total consumption of about 3 c.b.m. acetylene per hour, is sufficient. The welding flame need be only as large as in iron welding of equal thickness of material. With this torch the Canzler wire becomes liquid in a comparatively short time, therefore overheating of the material, and formation of oxide are prevented. The material is then stretched or extended by hammering with convex faced hammer and the tensions occurring upon cooling are so completely equalized, that when properly handled, no cracks will appear.

This stretching is best done in such manner that the seam is welded in sections 15-20 c.m. long, whereupon the operation is interrupted and both operators immediately and simultaneously commence at different points to hammer the dark red hot material until it has cooled off. While in this case a removal of the damaged part of the firebox is not necessary, nevertheless stays, rivets, etc., must be first removed, as the hot wall must always be permitted, to a certain extent, to expand or contract freely.

Patches have three edges welded into the wall sheet as a rigid whole. The fourth edge forms the riveted joint and caulking edge.

This engineer's method of welding the broken bridges of a copper tube plate is practically the same as that described elsewhere, but he stresses the need for using a welding paste manufactured by the firm of Canzler for all classes of copper welding as it effectively prevents the access of oxygen and even reduces any copper oxide which might be present. Anyone who has attempted to weld copper knows how readily it oxidizes and realizes the need for a de-oxidizing agent to secure an efficient weld.

With regard to the organization required for this class of work the psychological-technical aspect should be considered when selecting welders.

Blacksmiths are found as a rule the most suitable tradesmen for the work and they should be encouraged by the best possible renumeration. It is not advisable to ask copper welders to do iron welding intermittently and a clear line of demarkation should be drawn because of the peculiar nature of this work. Two Welders and an assistant should form one group and their duties confined to copper firebox welding.

The consumption in welding per hour as given by Bothe is as hereunder.

	Mark.
2 torches No. 5 = 3 ohm acetylene = 12 kg. carbide =	42.00
3.6 ohm oxygen =	17.64
1 kg. Canzler copper =	78.00
Total	137.64

The writer desires to draw attention to the optimism displayed by Chief Engineer Bothe in his concluding remarks, viz.:

"Experience has shown that due to the good heat conductivity of the copper, a local overheating of the basic material does not easily take place. In the practical application of the autogenous process for repairing damaged fireboxes, no doubt even better values of tensile strength and expansion will be obtained than in the experiments with sample bars. From this, it may be deduced that the tensible strength of a welding seam, amounts on the average from 55 to 60% of that of the solid copper. Contrary to this, the tensile strength of the usual single-row iron riveting in the fire box is only 40%. In view

of this difference in the tensile strength values in favor of the welding process, practical tests should now be carried out for the purpose of connecting copper walls in the manufacture of new fireboxes exclusively by autogenous welding.

The riveting method used at present is accompanied by many disadvantages, viz.:

1. The overlapping in the row of rivets, cooled only indirectly by water, are subject to premature wear, particularly in the fire zone.
2. Experience has shown that rivet heads, protruding into the water chamber, particularly in the fire zone, corrode and give trouble due to the influence of galvanic currents. A number of rivets, therefore, must always be renewed, preferably at every interior examination.
3. The rivet heads render a thorough removal of the adhering boiler scale difficult, when cleaning the boiler; in consequence, a thicker crust will accumulate just at these points in the course of time, so that the highly important water cooling (see item 1) is still more impaired.
4. The flanging of the tube and fire door plates is subjected to increased crack formations, because, owing to the rigidity of the riveting, only the short arch in the flange will stretch and it is exposed to constant bending strains upon heating or cooling of the firebox. This evil necessitates frequent and premature repairs.

All these disadvantages enumerated in item 1-4 might possibly be avoided by using the welding instead of the riveting method. Furthermore, the construction costs are reduced, because due to the elimination of overlappings in the row of rivets, plate copper is saved and no riveting and caulking work is required. In the welding of metals of all kinds, whether it is done in the fire or by autogenous or electric processes, it is well known that the quality of the basic material plays an important role. Copper, with its many uses in machine construction, forms no exception in this regard. Frequently enough, harmful admixtures (lead, arsenic, oxides, etc.) are the cause of failures, or at least of the low resistivity of some welding. If, therefore, in spite of the observation of all rules laid down for the copper welding, reverses occur now and then, they are always caused by the composition of the basic material. It is therefore advisable, in case of a complete failure of a welding operation, to investigate the causes and then to examine whether patching, lengthening of pipes, or a complete removal of the respective firebox parts would not be the better and more economic course.

This last circumstance makes it therefore appear advisable to carry out welding tests on a practical scientific basis. The author is of the opinion that the welding test would prove to be one of the best criterions of the quality of the material.

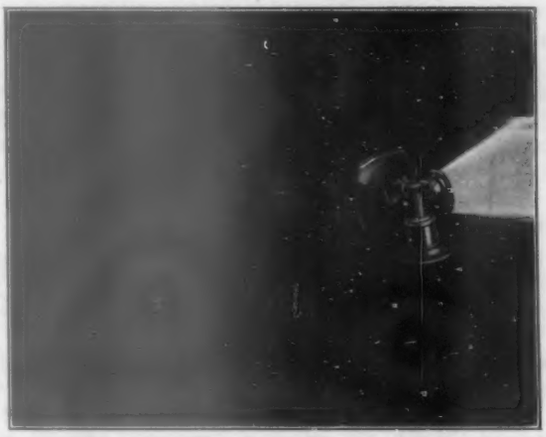
No doubt it would be of immense importance economically, if all modern welding processes could be developed to the highest perfection, and the controlling authorities would consent to establish a special field of study for this branch. This would have to embrace:

1. The organizing of welding schools and training stations for welders.
2. The testing of, and passing on all innovations in this field.
3. The carrying out of welding tests for the purpose of determining qualities of materials.

While this paper does not deal with all details connected with successful copper welding, sufficient information is given, in the opinion of the writer, to encourage the application of the process of autogenous welding on the lines disclosed in these notes. Reverses no doubt will occur and the analysis of the copper plate may be questioned and so on, but copper plates to British Standard Specifications are quite suitable for welding and more so, when annealed. Obviously great savings would be effected by any railway using copper fireboxes which are subject to fracture and cracking, necessitating the renewal of tube plates or patching of wall sheets and firehole plates.

NEW RAILROAD CARBON LAMP

At the recent exposition of the Railway Appliances Association which was held in the Coliseum, Chicago, the Air Reduction Sales Company displayed a new type of carbide lamp made especially for railroad work. This lamp is said to give a clear, white light of high candle power with strong projection and large illuminating area. They are provided



New Type Carbide Lamp for Railroad Work

with a large base and large carrying handle the latter is designed so as to make it easy to carry in different positions, the handle extending backward from the lamp to avoid the heat directly above the burner. All parts are readily removable for replacement if damaged.

APRIL MEETING OF CLEVELAND SECTION

The April meeting of the Cleveland Section of the American Welding Society was held in the Engineering rooms at the Hotel Winton, Tuesday evening, April 20th.

The speaker of the evening was Mr. A. F. Davis, of the Lincoln Electric Company, who presented a paper on "Welding of a Structural Runway," a job recently finished by the Morgan Engineering Company. This paper was accompanied with a series of slides showing the procedure. In addition to this some slides was shown on "The Arc Welding of Steel to Replace Grey Iron Castings."

NEW LINCOLN WATER COOLED HOLDER

Desirability of using the carbon arc for repair of defective castings in steel foundries has led to the development of a water cooled carbon electrode holder by the Lincoln Electric Company of Cleveland. In the past where the carbon arc was used for the repair of castings, when current up to one thousand amperes was required the use of very large carbon electrodes was necessary to prevent the excessive heat from burning up th holder. It was found that the use of large carbon electrode had the disadvantage of producing a rather unstable arc. The new water cooled carbon electrode holder is said to have overcome the difficulties mentioned. With this equipment it is possible to use a heavy current and a smaller carbon electrode, thus producing a stiffer and more stable arc. Currents as high as one thousand amperes can be used on electrodes one half inch in diameter.

Use of the carbon arc for burning out sand spots in place of chipping with an air gun is far more desirable from the view point of both the foundry and the customer. Owing to the high expense of chipping sand spots, it is said that the tendency is to correct the defects only on the surface. This of course means a spongy, leaky and weak casting getting by inspection.

WELDED ROTARY DIGESTERS

Constant danger of entire failure, leakage and the necessity of calking have now been eliminated in so far as rotary digesters, used for the purification of cotton linters for the manufacture of artificial silk, is concerned.

Through the application of electric arc welding, in place of riveting in the construction of these digesters the Richmond Engineering Company of Richmond, Va., has found it possible to produce a machine which gives consistently satisfactory service even under the most severe usage possible in an artificial silk mill.

To fully appreciate the importance of the part which arc welding is playing in the comparatively young artificial silk industry, it is first necessary to review briefly the process followed in making the product. Artificial silk is made from nitro cellulose dissolved in ether and alcohol, which in turn is made from cotton fibre.

Cotton linters provide the commercial supply of raw material for the industry. It has a great portion of oil, dirt and other foreign matter in it, which must be removed before it can be used in the manufacture of artificial silk.

Through a process of steam cooking under pressure, with a caustic soda solution it is purified. It has been found that the most satisfactory method for conducting this essential operation is provided through the use of a large steel pressure vessel, built to withstand high internal pressure, and adequate to handle an enormous unit charge of solution and cotton.

The vessels used for this work are known as rotary digesters and those manufactured by the Richmond Engineering Company are made of pressed steel plates ¾ inches in thickness; spherical in shape and 14 ft. in diameter. These great balls revolve on massive steel trunnions, the centers of which are hollow. Through fixed pipes, which enter the balls on the axis through the hollow trunnions, steam for cooking is admitted.

Welded Joints Prove Their Superiority to Riveting

Because artificial silk producers and manufacturers of digesters had found that rivets could not satisfactorily stand up under the severe use called for in these great vessels, extensive studies were made by the Richmond Engineering Company to determine upon a process which would give one hundred per cent satisfaction. Arc welding was the solution found in this case.

Using the "Stable-Arc welders, made by the Lincoln Electric Company, of Cleveland, the Richmond Engineering Company has been enabled to do a welding job which is constantly good, and which has eliminated all complaints of digesters leaking. There has never been a failure of the welded digesters, nor is there any possibility of there being in the future, for each one of the balls is tested by a water pressure of 120 pounds per square inch, before it leaves the Richmond plant.

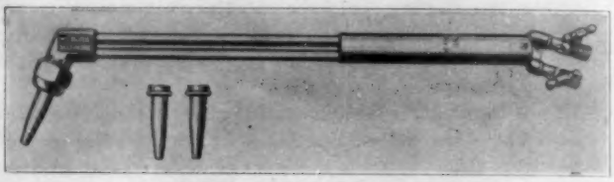
The builders of the digester now weld to the shell of the digester the lugs, which are bolted to the cast iron segment gear and the balls. Under this process no machine work is necessary in the manufacturing and installation of the big gear for the digester.

Through this type of construction vital portions of the machine become one integral unit; the welding serving to join the different parts with a strength equal to that of any of the steel members.

"This type of construction is much better than the older type of riveted construction," says Ernest W. Farley, of the Richmond Engineering Company. "Riveted construction was constantly developing leaks and required the attention of boilermakers for calking, and also carried with it the tremendous hazard of failure due to fatigue of the riveted joints."

MILBURN MARKETS NEW WELDING TORCH

To meet the demand for a small welding torch for work not requiring the usual standard torch, The Alexander Milburn Company, Baltimore, Md., has perfected the Type J-Jr. Torch. This is described as a sturdy, compact torch giving a high degree of efficiency and economy. The torch uses the same tips as are supplied with the standard larger torches and is adaptable to all classes of welding. It uses low and comparatively equal pressure of oxygen and acetylene. Due to its light weight, it is untiring to operate continuously. The quality of its work has been highly satisfactory. Comparison of its use with heavier torches is said to show savings in gas and a speeding up of the work.



New Milburn Welding Torch

The manufacturers claim that supermixing of the gases through a standardized system of multiple mixing assures a complete intermixing of the gases and a uniform flame. The seats of the tips are flat, with annular grooves coinciding with those in the head, the gas passages entering through the annular grooves or rings which separate the gases. The construction of these seating surfaces allow lateral expansion of torch head and tip without distortion and the seats are very easily refaced.

The J-Jr. Torch is adapted to gas supplied either from generators or compressed in tanks. The torch is made of bronze forgings and specially drawn tubing. It is very simple in construction, with all parts easily accessible.

An angle of 67½° in the head allows a natural position in operating the torch, utilizes the heat to best advantage and protects the operator's hands. Equally balanced, the torch is easily manipulated and will not tire the operator. The J-Jr. is 18 inches long, weighs 25 ounces and is furnished with three welding tips adaptable to a wide range of welding.

CYLINDER SAFETY BULLETIN

The National Safety Council, Chemical Section, Chicago, has just published a cylinder safety bulletin which may be obtained at a very low cost. This bulletin is 9x12 inches in size, and contains a very attractive illustration in black, gray and orange, showing a cylinder with the valve cover in place. The heading above the cylinder is "For Safety." In the lower right hand corner appears the following copy: "When cylinders are not being used—whether they be full or empty—keep valve and covers in place." This is a very wise safety precaution and one which cannot be emphasized too much.

PREVENTING SPUTTERING

A patent has recently been issued which is claimed to prevent sputtering in welding iron or steel. The surfaces to be welded are treated with a solution of chronic acid, and are then allowed to dry before welding.

Keeping the Welder in Condition

Methods Used in Improving Old Generators—Points to be Observed in Order to Keep Machines in Good Operating Condition

By M. D. Goodman*

IN a wide experience repairing and rebuilding electric arc welding machines many instances have occurred where improvements have been incorporated which actually gave them better welding characteristics than they had originally.

It has been found in some cases that by changing the stabilizer or redesigning the old one better welding characteristics were obtained. Some types of welders which originally did not have stabilizers also may have their characteristics improved by the addition of a properly fitted stabilizer.

Some types of welders have rather large and complicated control panels. In rebuilding these it is best to completely redesign the control thus making it as compact and simple as the most modern type arc welder.

How Arc Welders Are Rebuilt

A brief outline of what is meant by rebuilding electric arc welders is as follows: First of all the windings themselves must be sound and if they are not, there is but one thing to do and that is rewind the machine. However, comparatively few machines need complete rewinding. The usual procedure is to take the welder completely apart in order to make a careful inspection of the various parts of the machine. If the machine has been standing a long time it is baked out and completely reinsulated. Most machines, however, need only the addition of a good insulating varnish to the winding to make them as good as new. The brushes frequently need to be renewed and occasionally bearings must be replaced. At rare intervals a shaft becomes worn. This shaft is built up by arc welding and turned down to the original size making the shaft the same as when it left the factory.

The control and stabilizers are very important items that must be considered in rebuilding welders. As far as the control is concerned if the original panel is excessively large a more compact panel is made and frequently new instruments are added.

In the case of stabilizers the air gap is sometimes changed if it is felt that the welding characteristics can thereby be improved.

Some arc welders are designed originally for about 40 volts. This is a little low and in a case of this kind the machine is actually redesigned to give at least 50 volts and much better welding characteristics are obtained. Of course on real modern machines no redesigning is necessary.

Keeping Machines in Good Order

Concerning the upkeep of welding machines, when the commutator gets a bit rough it should be sand papered and the brushes should always fit the commutator properly. The most frequent cause of sparking is an improperly fitted or incorrect brush.

A good many arc welders use ball bearings. These bearings ought to be inspected every six months or so to see that there is sufficient grease and that this has not become hardened. If the bearings are not properly greased they will become defective and will have to be replaced.

Sometimes sleeve bearings are used on welders and where this is so, special care should be given the bearings, particularly in portable outfits.

In a sleeve bearing the oil ring must be in its groove to lubricate the bearing properly. Occasionally, when moving a set the ring will jump out of its groove. When this occurs the bearings get hot due to insufficient oil supply.

A very satisfactory method of getting portability in welders without actually putting the entire machine on a truck is to mount the welder on a steel or wooden platform designed to be handled by an ordinary lift truck. In this way the machine is on a fairly good foundation and yet has portability.

For Arc Welding Sheet Metal

Those readers who have experienced difficulty in successfully arc welding light sheet metal such as 18 gauge or so on their 200-ampere machines will be interested in the following experience. Recently a welding shop owner came to our plant and said that if he could get an arc welder that would weld 18 gauge steel without burning through he could get a big job. He was told that a simple device could be added to his 200-ampere machine which would permit him to do this work. The following day this welder started welding up sheet steel pans made of 18 gauge steel which he had previously thought impossible to handle with the electric arc.

Not Too Much Speed on Gas Engine Sets

Gasoline engine drive welders are now getting more common. With this type of machine special care must be taken to get continuous operation. The engine must be of the heavy duty type and have a normal speed of not more than 1200 RPM. It is true that gasoline engine drive welders are being used at speeds as high as 1500 RPM but if one will follow the history of such sets it will be found that the engine needs complete overhauling in from six months to a year if used on steady work.

Gasoline drive arc welders are sometimes arranged for gear drive. This makes a satisfactory unit where the gearing is properly designed. However the direct connected unit is satisfactory and this design is being used more and more.

Probably many readers may have experienced difficulty in holding the arc on gasoline drive sets. One of the most frequent reasons for this is a slow acting governor on the engine. If the governor works quickly when the load is thrown on the machine the speed of the generator and hence the voltage will be maintained. This will produce good welding. If, however, the governor is slow, the speed will drop and the voltage reduced. This, if carried far enough, will make it difficult to hold the arc.

Wherever possible the electric driven unit is to be preferred to the gasoline engine drive. The electric drive costs less initially, costs less to maintain, is simpler and is more likely to be in continuous operation from one end of the year to the other.

One question that is frequently put to the writer is this: "What is the best electric welder." The answer is invariably as follows. Practically all makes of welders are good as far as actual welding is concerned. The difference comes in the efficiency, and capacity and there are also differences in design. Here the personality of the buyer comes in. In one case a separately excited machine will appeal while in another a self excited machine will offer the strongest appeal.

When it comes to selecting a rebuilt machine, the make of machine is of much less importance than the company from whom the rebuilt welder is obtained. A welding machine is a specialized product. In getting a rebuilt machine it is best to go to a company that specializes in this sort of machinery.

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SPRING MEETING OF THE AMERICAN WELDING SOCIETY BRINGS MUCH DISCUSSION OF WELDED DESIGN

Design of joints for welded structures was the outstanding topic of discussion at the technical sessions of the American Welding Society on the occasion of the Spring meeting which was held in New York last month. The discussion of this subject was opened by Mr. E. E. Thum, of the Linde Air Products Company, who presented a paper on "The Design of Oxwelded Equipment." Mr. Thum pointed out in his paper that the subject of design covers not only the matter of sketching an individual joint or a combination of joints but also the correct design for each step involved in the application of the process, in other words, intelligent control must be exercised over the selection of materials, the training and selection of operators, the actual welding procedure, and testing of the finished work. A few important welding operations on large steel structures were described to show the advantages of the welding process when carried out under this supervision and control. The following general principles were recommended covering the design of the joint itself.

First. Arrange so that the plane can penetrate and melt the metal to the very bottom of the joint without excessive overheating.

Second. Avoid welds between metals of widely different cross section.

Third. Avoid placing a weld where compound stresses must be carried, especially places where a slight movement will induce much split or prying action.

Fourth. Avoid intersections of welds meeting as they cross.

L. J. Sfoizini, of the Engineering and Maintenance Department, Kodak Park, Rochester, New York, presented a paper on "Welding in the Design of Industrial and Power Piping." This paper described the four principal classes of ordinary non-welded joints encountered in pipe work and discussed their advantages and disadvantages, so as to make clear what is required of welded joints. He then described the advantages and methods of welding on high pressure steam piping, low pressure steam piping, refrigeration piping, brine piping and air and water piping. It was ponted out that in designing a piping system a factor of safety of at least six is used and that this factor should also be used in welded work. It was also pointed out that even though welded joints are known to have occasional failures, such failures are quite common with all other types of joints. By making rigid restrictions on the use of welding such failures are kept at a minimum.

L. H. Burkhart, Chief Engineer of the Struthers-Wells Company, described the design and manufacture of a horizontal cylindrical pressure tank. This is a 48 inch tank, 15 feet long, to be used as an air or steam receiver under 250 pounds pressure. If properly made it will easily stand the test of 500 pounds hydrostatic pressure.

A. C. Vick, Plant Engineer of the Detroit Range Boiler and Steel Barrel Company presented a paper on "Gas Welded Longitudinal Seams for Stringent Requirements," using as an example a fabrication of bilge barrels. These barrels are made by first welding a longitudinal seam in a cylindrical shell rolled to that shape from flat plate. After welding the shell is placed in an expanding arbor, which increases the diameter at the center of the barrel from 21 inches to 24½ inches, the end still remaining at 21 inches. Careful study of welding methods has made possible a continuous reduction of the percentage of failures and it requires a high quality of workmanship to keep failures at a minimum, because the finished product is required to pass extremely severe tests.

S. W. Miller, Consulting Engineer, Union Carbide and Carbon Research Laboratories, spoke on the subject of "The Design of Welded Joints." Mr. Miller's paper emphasized the importance of using a procedure control to cover the various steps and items that are involved in successful welding operations. The various steps in this control are: workmanship, methods, design, preparation, welding, and testing. On the subject of materials Mr. Miller pointed out that tank steel is not good for important welded structures because its welding qualities are frequently undesirable and that fire-box steel is most suitable for important work. He stated that the only fair basis for design in the case of welded structures is to use a maximum work and fiber stress, based on either the tensil strength of the plate or the tensil strength of the welding metal, whichever is the lesser.

J. W. Owens, Director of Welding, Newport News Shipbuilding and Dry Dock Company, discussed the subject of "Design of Welded Joints in Ship Construction." In introducing this subject he stated that practically every form of welding can be advantageously used in the repair and construction of ships, provided each form is utilized for the class of work to which it is best adapted. Ship structures intended to be joined by welding instead of riveting should be specially designed with that end in view, in order to save the maximum weight without sacrificing strength and to permit as much welding as possible to be done in the shop a number of assembly holes should be the minimum required for assembly, as additional holes can be punched on the job if necessary. In general he recommended the making of welds continuously, unless otherwise specified.

Several engineers and construction men interested in the possibilities of welding for large construction were present at the technical sessions and took an active part in the discussion of the papers. In their opinion there is still a great deal of information lacking which structural engineers and fabricators must have before they can adopt the process on a large scale. They have been persuaded that welded joints are economical and efficient for many kinds of work but they have not been given the engineering information which they need in order to go ahead with the application of it in individual cases.

The program of the Spring meeting included, also, important committee meetings, business sessions, an inspection trip to the plant of the Metal and Thermit Corporation, a dinner dance and meetings of the American Bureau of Welding and of the Board of Directors.

PROMINENT GERMAN ENGINEER STUDIES AMERICAN WELDING METHODS

During the past month Fr. H. H. Max Fuschel, a member of the central office of the German State Railway System, and chairman of the welding committee of the German Engineers Society, has been making a tour of inspection of research laboratories and welding departments of large industrial plants in the United States, getting a close-up view of the methods and applications of the different welding processes here. While in Chicago he visited the editorial offices of The Welding Engineer. His account of differences in procedure and application in the two countries was exceedingly interesting, and indicates marked differences in apparatus, materials and labor conditions.

CLEVELAND STEAM FITTERS PLAN TO TRAIN WELDERS

So much interest has been shown in welded pipe joints in the Cleveland district as a result of a considerable volume of successfully welded piping installations that a demand for well trained operators is anticipated. It was reported a short time ago that the steam fitters union had been following the developments with great interest, with a result that they now desire to make preparations so that as this volume of work increases the welding can be done by union men. On this account they have lately been planning to establish a course of instruction with a capable pipe welder acting as instructor.

WELDING FEATURED AT CHEMICAL EQUIPMENT SHOW

The week of May 10th to 15th was Chemical Equipment and Machinery week in Cleveland, Ohio. An exposition of chemical equipment and processes was held at the Cleveland Public Hall, under the auspices of the Association of Chemical Equipment Manufacturers. Technical sessions held at the Hotel Hollenden were under the auspices of the Associated Technical Societies of Cleveland. The technical sessions and the exposition gave visitors an opportunity to study the whole range of industrial processing methods.

The gas and electric welding processes were featured prominently at the exposition and it was apparent that all of the different exhibits pertaining to this industry received their full share of attention and interest. Directly facing the main entrance to the exhibition were the booths of the General Electric Company and the Linde Air Products Company. The General Electric Company exhibit contained a range boiler automatic arc welder on which demonstrations of automatic arc seam welding were given throughout the week. The Linde Air Products Company had complete gas welding and cutting equipment for display and also a varied showing of welded jobs. A special fitting of 20 inch pipe, partly completed, was exhibited on the first day and in the course of the week it was used to demonstrate the fabrication of special fittings with the torch. The completed job of welding a double coil heat interchanger, eliminating fittings at the bend was on display. Other samples of heat interchangers and welded drip pots for pipe lines were shown. As part of the demonstration work during the week, a steel pipe railing was fabricated with the use of the bronze filler rod.

Directly across the aisle from the Linde exhibit was the booth of the Pittsburgh Testing Laboratories. This was equipped with a tensile testing machine for pulling welded samples. The booth also was equipped with a complete welding outfit and test specimens already prepared for welding. Welders were invited to try their skill on the sample coupons and have them broken in the testing machine. If the results did not seem to be satisfactory they were invited to take their broken welds to the Linde booth across the aisle and receive some criticism and instruction, then go back and try it again to see whether they were able to improve their work.

The Electric Arc Cutting and Welding Company had a display of their Alternarc A. C. welding equipment and their Dualarc combination A. C. and D. C. welder. Mr. Fischel was in charge. Specimens of arc welded joints in alloy steels, such as are used in chemical equipment, were prominently displayed.

The Air Reduction Sales Company featured in their exhibit cylinders containing various gases derived from the atmosphere by the Claude Liquefaction process. They also had on hand containers of liquid oxygen and liquid nitrogen. Much interest was shown in the demonstrations of the interesting qualities of liquid oxygen. In addition to featuring atmospheric gases they had on display a representative display of their oxy-acetylene welding and cutting torches, supplies and etc. While actual demonstration of apparatus was not made, they carried on oxygen purity tests at frequent intervals, showing visitors how it was possible to make tests to determine the purity of oxygen contained in cylinders.

In the booth of the United Alloy Steel Corporation there were displayed a number of samples of welds made in stainless steel and photographs of a variety of products made of this alloy by welding. The display of the welded samples and photographs was in charge of Mr. W. C. Johnson, of the Industrial Welded Products Company, Newark, New Jersey, a firm which specializes in the production of welded equipment.

The Welding Engineer and *The Welding Encyclopedia* were displayed in the booth of The Welding Engineer Publishing Company. Special attention was given in this display to the different pieces of literature which are used by *The Welding Engineer* to assist executives in the training of operators and keeping the welding departments informed of the current developments in the different welding processes. In order to emphasize the desirability of a closer acquaintance with welding on the part of foremen and supervisors, a number of sample welds which were known to contain certain defects were shown and prizes were offered to any one who cared to inspect the work and pass judgment on the quality of it. Later in the week these coupons were broken in the booth of the Pittsburgh Testing Laboratories so as to have a definite check on the real comparative qualities of the various welds.

In addition to the publicity given to the welding processes by this series of exhibits the subject received specal attention at the technical session held Friday, May 14th, when Mr. A. O. Miller, of Reeves Brothers Company, presented a paper on the subject of "Welding of Large Chemical Equipment." This was an excellent paper and well received and paved the way for some good discussion.

Mr. R. K. Randall, Director of the welding department of the Cleveland Y. M. C. A. School of Technology, brought his entire class to the exposition on the evening of May 14th, this visit taking the place of one of their regular sessions at the school. He had previously arranged with exhibitors to schedule special demonstrations of welding by different processes to take place during the time when his students would be present to observe them. In this way men who were just learning the fundamentals of the subject were given a chance to see some actual work being done under the direction of thoroughly experienced operators.

These are some of the high spots of the importance of this exposition to the welding industry. It furnished an excellent opportunity to bring the process to the attention of many engineers and industrial executives who could certainly learn enough regarding its possibilities to be favorably impressed and to solicit additional information and suggestions in the future. There is no question but that many new fields of welding will be opened as a result of the work done at the exposition and many men will become converted to the value of welding.

G. O. CARTER TALKS TO CHICAGO SECTION

On Friday evening, May 7th, G. O. Carter, Consulting Engineer of the Linde Air Products Company, read a paper on the subject of "Procedure Control" before the Chicago Section of the American Welding Society. In this paper he pointed out the need for supervision of welding operations by men who were well enough acquainted with the principles of the operations to know how to get the desired results. He described a number of cases where welding had been used on very important construction and where careful planning of the work and intelligent supervision had resulted in perfect satisfaction. After explaining the meaning of "procedure control" he showed a long series of lantern slides which illustrated typical jobs performed with the oxy-acetylene torch and also some of the ingenius devices which had been used in the past to overcome some of the common difficulties. This is the final meeting of the Spring program for the Chicago Section. The next meeting will be held the first Friday in September.

The Ohio Electrolytic Oxygen Co., 934-946 Kenyon Ave., Cincinnati, Ohio, announces that the corporate name of the company has been changed to the Ohio Valley Oxygen Company. In 1914 this company produced oxygen by the electrolytic process, but today the greatest percentage of oxygen is produced by liquefaction of air. For this reason the name changed has been deemed advisable.

NEW ACETYLENE PLANT OF INDIANA OXYGEN COMPANY

Late last Fall the Indiana Oxygen Company completed a new acetylene plant at Beech Grove, Ind., a suburb of Indianapolis and it has been in operation since October.

The plant consists of five buildings, steel and sheet metal construction, with ample space between them, so in case of accident the whole plant is not endangered.

Beginning with the entrance to the plant, on the right of the drive is a six room cottage for the operator in charge. The first plant building on the left is the warehouse. Here all carbide in 100 lb. cans is stored, also all empty and full cylinders pass through this building, for the platform scale for weighing is located there.

Indiana Oxygen Company's New Acetylene Plant Has Been in Operation for Several Months

The second building is the charging house. Between this building and the warehouse extends a concrete platform of sufficient capacity to take care of a large number of cylinders. Both buildings and platform are of truck height.

The third building on the left of the drive contains the compressor and purifiers, the building having a partition and making two large rooms.

The first building on the right of the drive is the boiler house, containing the heating plant with oil burner, water pumping system and work shop.

Directly to the rear of the boiler house is the generator house. Two stories in height, with lower or first floor at truck bed height. To the side of this building is a large platform for generator carbide storage.

Immediately to the left of this platform and directly behind the compressor and purifier building is the gas holder.

Provisions have been made in all the buildings, so that the capacity of the plant can be doubled without additional building. The plant is equipped throughout with all known safety devices, the main thought being safety.

Building and equipment are of the most modern type, Oxeco seamless monolithic filled cylinders are used and supplied to customers on a free loan basis.

This makes the third plant to be operated by the Brant Brothers of the Indiana Oxygen Company, the other plant being the Wisconsin Oxygen-Hydrogen Company at Kenosha, Wisconsin.

CUTTING PAINTED STEEL

The Journal of Industrial Hygiene, March, 1926, contains an article dealing with lead poisoning among oxy-acetylene welders. This has been studied by the Chemical Welfare Service in the scrapping of naval vessels. A brief account of the general procedure in scrapping ships is given and a large amount of data is presented in tabulated form and analyzed from the medical standpoint. It was found that the poisoning in sixty-nine cases examined was due to the inhalation of lead volatilized from fumes arising from burning of paint adhering to the scrap metal. It is therefore advisable to provide the welder with some means of removing the paint from the metal parts to be cut or welded, so that he will not be subjected to these fumes. It may also be advisable, when a great deal of this work is done, to provide the operator with a gas mask.

GAS PRODUCTS ASSOCIATION CONVENTION NEXT MONTH

June 21-22-23 are the days announced for the annual Mid-Summer meeting of the Gas Products Association. This year the meeting will be held at French Lick Springs Hotel, French Lick Springs, Indiana. This is an ideal convention spot because it offers ample facilities for meetings and also an almost unlimited variety of pleasure and recreation in good surroundings without any distraction. This convention is an event to which many members of the oxy-acetylene industry look forward with considerable pleasure. It enables them to get together, not only for a discussion of technical and business matters pertaining to the oxy-acetylene industry but also for recreation and closer acquaintance. The membership of the association comprises manufacturers of oxygen and acetylene and manufacturers of equipment and supplies used throughout the oxy-acetylene industry. It is national in scope and has members in nearly every state in the Union. Mr. C. T. Allen, Secretary of the Gas Products Association, has issued a general invitation to the active and associate members to come to the convention and bring their families with them. Those who have attended previous conventions know that the meeting will provide plenty of pleasure and recreation and at the same time there will be enough discussion in the course of the different sections to make attendance very much worth while from a business standpoint.

WELDED LOCOMOTIVE TENDER

A new field for electric arc welding is promised as a result of the use of this method by the Boston & Albany Railroad in constructing the tender tank for one of its locomotives. This tank, with locomotive No. 513 of that road, has been in service approximately five years during which time it has traveled more than 200,000 miles.

The accepted method of locomotive tank construction has been riveting. This process, since its inception, has been the standard practice and engineers have devoted their energy to the development of tools and machinery with a view of reducing the production costs. Today the riveting process, at its highest state of development, is very costly both in original construction and in maintenance.

In January, 1921, the Boston & Albany Railroad, realizing the great possibilities of electric arc welding, built at its West Springfield shops a locomotive tender tank constructed throughout by General Electric arc welding equipment, with the exception of the safety appliances such as grab handles. This method of construction practically eliminated all laying out, punching and drilling of sheets, angles and T-braces, together with reaming, riveting and caulking.

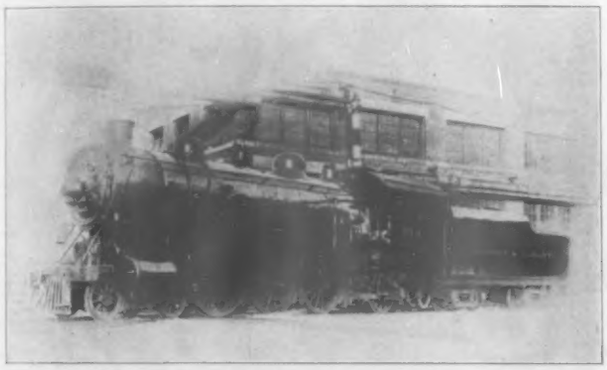
The tank was constructed of ¼-inch plate, and was of the

following dimensions: 26 feet long, 10 feet wide, and 5 feet 2 inches high. It has a water capacity of 8,000 gallons and can carry 12 tons of coal. Tees used are 3½x2 1/2 inches spaced 28 inches from center to center. Angles are 2 1/2x2 1/2x⅜ inches, except on the wash board and coal door.

The following details show the number of feet of welding necessary to construct the tank:

6 seams butt welded across tank @ 10 feet	60 feet
4 angles to plates front and back @ 40 feet	160 feet
4 angles to plates sides @ 86 feet	344 feet
6 seams vertical @ 5 feet	30 feet
10 tees to bottom and top @ 40 feet	400 feet
23 tees to sides @ 5 feet	115 feet
Beading to dickey, 2 sides œ 12 inches	2 feet
24 splash plates @ 12 inches	24 feet
Total	1135 feet

In the average tank of this capacity there are approximately 7,000 rivets with a total weight of 800 pounds and the number of holes punched in sheets, angles and T-braces would be approximately 15,800. The welding rod used in the construction of the Boston & Albany tank weighed approximately 398 pounds.



Locomotive Tender With Welded Tank Holding 8000 Gallons of Water and 12 Tons of Coal Shows no Defects after Five Years Service Over 200,000 Miles.

In the welding of T-braces to the top and bottom of the tank, the weld was continuous for its entire width. This was done to eliminate the water scoring and rust prevalent on the riveted type of tank.

The tank, when completed was mounted on a Commonwealth Steel frame, arch bar trucks, on a Pacific locomotive, and placed in service February 6, 1921. Since that time no defects have developed in any welded joint, and the total mileage covered is 201,563.

BUILDING AN ALL WELDED WHEEL

By G. L. Wright

The draft wheels on tractor potato diggers which we built have always given us considerable trouble until we used welding as a means of making them. These wheels are 3 inches in diameter with a ⅜ inch by 5 inch tire and twelve ⅜ inch by 1¼ inch spokes. The hub is 7 inches long and fits a 1¾ inch axle. Before welding was used we used a cast hub weighing 28 pounds. The foot was turned on each end of the spokes and the spokes were then riveted with ⅞ inch rivets to the hub and to the tire. The cast flanges on the hub usually broke and the spokes broke at the rivet holes. If the spokes did not break, the rivets worked loose and sheared off.

Two years ago we decided to try and build welded wheels. This proved so successful that we have been building them that way ever since, and up to date we have not had one single complaint on the welded wheels, while we often had to repair the riveted wheels the first season.

The welded wheels are built as follows:

We bend and weld the tire and cut the spokes. The spokes are made from a 2½ inch extra heavy gas pipe. Two washers are cut from ⅜ inch boiler plates, 6 inches in diameter, with a hole a little larger than the pipe. The pipe and washers are heated in the forge, and the washers are welded 1½ inches from each end of the pipe. They are welded around the inside of the washer only. The spokes are next placed in position on one of the washers, leaving about ⅜ of an inch between the spoke end and the pipe. The spokes, washer and pipe are then welded together in one operation. The wheel is then turned over and the operation is repeated. We keep the flame of a kerosene torch playing on the hub while welding it. This we have found saves time and cost.

The next operation is to place the tire around the spokes and true the wheel. We slip the hub on a mandrel clamped to the welding table. After the wheel is trued the spokes are welded to the tire. The kerosene torch is used to heat the spoke end before welding the spoke to the tire. The torch is played on the next spoke to be welded, so that we always have a hot spoke to work upon. The last operation is to babbitt the hub to fit the axle.

The comparative costs were as follows:

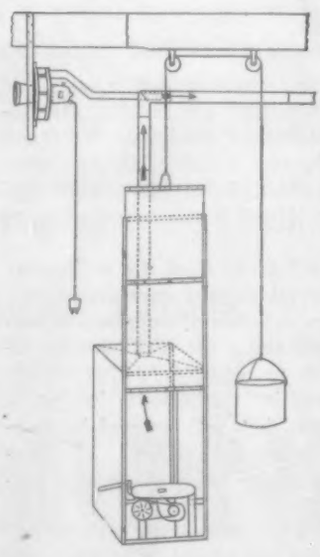
	Riveted Wheel	Welded Wheel
Material	$8.34	$5.14
Labor	8.25	4.00
Oxygen, @ 2c		1.00
Acetylene, @ 1½c		.75
Welding Rod		.30
Kerosene		.20
	$16.59	$11.39

Welding has proved so successful on this work that we now use it in a number of places on the digger frame where riveting was formerly used. We have never had to give any service on our welded products, although we have often been called upon to put in new rivets or repair parts that had been riveted.

HOME MADE WELDING BOOTH

By Chas. Haeusser

In the winter months when we had a charcoal fire in our shop, and did a great deal of bronze welding on greasy and painted work, the smoke would feel very thick and annoying. It was too cold outside to permit opening the doors and windows for ventilation, and of necessity we rigged up a life-saving welding booth.



Welding Booth

We constructed it of 4 sheets of 20 gauge black sheet, 48 inches by 96 inches. The frame was made from 1 inch x ⅛ inch angle iron, and the two front angles were 12 feet long. One inch angle iron reinforcements were spot welded to them on the outside edge. This allowed the counterweighted door to slide up and down. The whole booth was made by welding, riveting and bolting. An old vacuum cleaner motor and fan, bought for a few dollars, was used to force out the smoke and heat. You will note that the lower pipe extends into the horizontal pipe leading to the chimney, thus forming an ejector, syphoning out the smoky air from the booth and making welding a pleasure.

THE HEYLANDT OXYGEN LIQUEFIER

The Heylandt Sales Company, 140 South Dearborn Street, are introducing a demonstration Liquefier which should prove to be of great value to educational institutions and commercial laboratories where small quantities of liquid oxygen are often needed for demonstrations and low temperature research work.

This Liquefier is a simple and practical device which liquefies air, oxygen or any other gases available under compression. It is made to fit a standard oxygen cylinder valve in exactly the same manner as a regulator. By allowing the compressed oxygen to expand in the Dewar flask of the Liquefier, through a small expansion valve, liquid oxygen can readily be produced within five minutes. A window in the flask makes it possible to observe the formation of the liquid and this is the only device ever made that allows the observation of this phenomenon.

The Heylandt Oxygen Liquefier.

The Liquefier is intended principally for high schools and colleges where physics and chemistry are taught. Heretofore only large institutions could afford a Liquefaction Plant for their laboratories. The Liquefier which really has more educational value than a plant itself, due to the visibility of the phenomenon in the former, is well within reach of every high school.

The oxy-acetylene industry will profit from the widespread use of these Liquefiers. The actual oxygen consumption will be necessarily small because one cylinder of oxygen will produce over one-half pint of liquid, and a few such demonstrations per year are all that will be required in the average school. Nevertheless, students in institutions having a Liquefier will learn about oxygen; they will learn of its wonderful characteristics and commercial applications. The oxy-acetylene industry as a whole is bound to benefit from a general dissemination of such knowledge.

Thousands of these Liquefiers are in use in schools and colleges in Europe. It is being introduced in America to meet a real need for such equipment.

In principle the Liquefier is a miniature column constructed along the same principle as the column in a commercial oxygen plant. It has no moving parts and with ordinary care will last a lifetime. It comes packed in a neat carrying case which makes it readily transportable as the total weight is less than thirty pounds.

The device was given an enthusiastic reception at Northwestern University May 13th, as a result of a demonstration by Mr. Otto Adams, of the Heylandt Sales Company before a class in chemistry.

An instruction booklet that accompanies each Liquefier describes many of the interesting and spectacular demonstrations that can be made with liquid oxygen which is almost 300 degrees below zero F.

VITRIFIED METALLIC TILE OPENS MARKET FOR CUTTING TORCHES

Over eight hundred booths were used in the recent Detroit Builders and Better Homes Show to exhibit building materials and equipment for new homes. The exhibit of the Vitrified Metallic Tile Roofing Company was one of the feature attractions of the show, according to Mr. N. J. Burgett, general manager of the company. This roofing material was described in a recent issue of *The Welding Engineer* and it was pointed out that the only successful way to cut it to

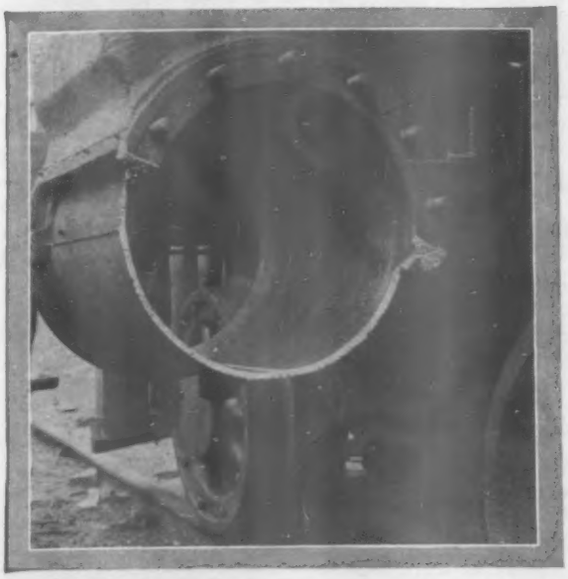
The Cutting Torch Got Some Publicity Here

special sizes was by means of the oxy-acetylene cutting torch. Roofers, contractors, architects and sheet metal dealers from surrounding states inspected this roofing material and showed great interest in the various tests which were available to show its qualities. It is stated that the results from the show were very satisfactory. The particular point of interest to members of the oxy-acetylene industry is that the question came up over and over again as to how these shingles could be cut. Hundreds of sheet metal workers have been made into prospects for new cutting torches as a result.

BIG WELDING SHOP PLANNED FOR PORTLAND, OREGON

King Brothers Boiler Works, Portland, Oregon, located at 700 East 17th street, have let the contract for the construction of a 50 by 200 foot welding shop on 18th and Lafayette streets, opposite their present plant. The building will have concrete base and floor, with walls of corrugated galvanized iron, and will cost between $7000 and $8000. Equipment costing $50,000 will be installed by which a complete welding service can be rendered.

Arthur R. King is president; Fred C. King is secretary-treasurer and Edward R. King, manager of the company. The business of the company has increased 50 per cent in volume each year for the past three years. The company is now installing $100,000 worth of additional equipment, including two large rollers.



Welded with Tobin Bronze without Dismantling

This type of repair to a locomotive cylinder formerly necessitated dismantling the cylinder and pre-heating the casting before the weld could be made.

By using Tobin Bronze, the broken flange was welded in place at a dull red heat, with the Oxy-Acetylene flame, without dismantling the casting, at a great saving in time and expense. And the weld is stronger than the original cast iron.

Tobin Bronze Rods, an exclusive product of The American Brass Company, can be secured from leading Distributors.

Descriptive pamphlet, including table of weights, melting points, also suggestions for welding with Tobin Bronze, sent upon request.

THE AMERICAN BRASS COMPANY
GENERAL OFFICES: WATERBURY, CONNECTICUT
Offices and Agencies in Principal Cities
Canadian Mill: ANACONDA AMERICAN BRASS LIMITED
New Toronto, Ontario

TOBIN BRONZE
REG. U.S. PAT. OFF.
WELDING RODS

NEW SCORED CYLINDER PROCESS

A machine and a process for repairing scored cylinders with the use of the welding torch, which involves no preheating of the cylinders and therefore gives rise to none of the usual difficulties resulting from the effect of heat on the cylinders, has been evolved and perfected by J. H. Klassen of the Golden Welding Works, Los Angeles.

The machine which Mr. Klassen has invented and which

New Machine for Inlaying Scored Cylinders

has become a feature of his welding shop, is so accurately gaged that it produces a mechanically perfect inlay, and the process has proved so dependable that an absolute guarantee goes with the work.

Not only can the work be done with mechanical accuracy, but it can be done quickly and economically and without enlarging the bore. The original pistons, rings and pins can be used. No solder is used and no Klassenite inlay ever has been known to come out, according to Mr. Klassen, nor is any cylinder so badly scored that the copper inlay cannot be used to place it in as good condition as before.

The whole process, Mr. Klassen says, depends upon the treatment of the copper by means of the welding torch, and the mechanical action of the machine which combines the actual inlay of the copper with a hardening process which produces the same coefficient in the copper as that of the iron of the cylinder.

MASTER STEAM BOILER MAKERS MEET

The Master Steam Boiler Makers' Association is going to hold a convention at the Hotel Statler, Buffalo, New York, on May 25th to May 28th, inclusive. The Boiler Makers' Supply Men's Association, with Mr. W. H. Dangle as Secretary, is arranging for the exhibit and entertainment for the convention. In the past this association has always had very good papers on welding, and the program for this coming year also shows a wealth of valuable material of interest to everybody concerned in the promotion of welding.

OXYGEN PURITY FOLDER

The Air Reduction Sales Company has just issued a folder on high purity oxygen. This folder is 20 inches by 16½ inches in size, and is printed in black and orange on a very good grade of white paper. An editorial from Industrial Gases, published in London, is reproduced on one page, and on the other is a very striking illustration of the Airco Oxygen cylinder, the stamp used to identify the cylinder, and the tag which guarantees the purity of oxygen contained in the cylinder. This broadside is being mailed to all users of Airco Oxygen.

NEWS OF THE WELDING TRADE

E. L. Mills, Sales Manager of the Bastian Blessing Company, Chicago, is the proud father of a nine pound boy, born Wednesday morning, May 12th.

J. J. Crowe, of the Air Reduction Sales Company, read a paper on the efficiency of oxygen purity for cutting in foundry practice for the Pittsburgh Foundrymen's Association, on Monday evening, April 19th. Mechanic cutting tests and oxygen purity tests were demonstrated.

It is reported that a 30 thousand dollars addition is planned for the plant of the Louisiana Oxygen Company at Mobile, Alabama, the addition to be for the production of acetylene.

The May luncheon of the Compressed Gas Manufacturers Association will be held at one o'clock, May 20th, at the Hotel Astor, New York City.

Following the luncheon meeting of the Atlantic Section of the A. S. M. E. inspection visits will be made to the plants of the Standard Products Company, The Liquid Carbonic Company and The Linde Air Products Company to see the manufacture and testing of gas products.

The Chicago office of the Commercial Acetylene Supply Company has recently moved from the Railway Exchange Building to the Fifth Floor of the Otis Elevator Building, 1600 West Jackson Boulevard, Chicago.

The following have recently been added to the membership of the Compressed Gas Manufacturers Association:

Newport Manufacturing Company, Milwaukee, Wisconsin, manufacturers of oxygen and hydrogen.

British Oxygen Company, London, England, manufacturers of oxygen and other industrial gases.

Gas Engineering Company, Trenton, New Jersey, manufacturers of gasholders and gas generating equipment.

The Chicago office of the Thomson Electric Welder Company has been moved from 817 West Washington Boulevard to 549 West Washington Boulevard, Chicago.

Smith's Inventions Incorporated announce a change in name to Smith Welding Equipment Corporation. This change in name will in no way affect the policy or personnel of the company.

CURRENT WELDING LITERATURE

THE ARC WELDING OF SEAMS IN STEEL PLATES—Discussion of a paper read before the Institution of Welding Engineers, by J. T. Carr—The Welding Journal, London, April.

GENERAL ASPECT OF WELDS ON SHEET STEEL—The appearance of welds made in material from 25 gauge to ⅜ inch thickness. Up to a certain point the appearance is an element of control for an experienced observer. The latter can detect evidence of unskilled workmanship and also poor quality in deposited metal.—The Welding Journal, London, April.

ELECTRIC WELDING IN THE DESIGN AND FABRICATION OF PLANT AND STRUCTURES, by J. N. Reeson—The employment of welding without special consideration of design is likely to cause dissatisfaction. Hundreds of tests have been made to obtain information on the strength of welds, the effect of corrosion and the cost compared to riveting.—The Welding Journal, London, April.

OXY-ACETYLENE TIPS—Monthly publication of the Linde Air Products Company. The May issue opened with an article on the "Stelliting of Metal Parts," discussing the uses of stellite and describing the procedure for applying it with the welding torch. The cast iron welder will find an article on test methods giving recommended practice for the operator who is anxious to turn out good work. For the job welder there is a job described and illustrating the construction of a welding rod holder which takes care of several different kinds of filler rod in a convenient manner. Another article gives a complete discussion of the application of oxy-acetylene welding in the construction of metal furniture, with many illustrations to show the value of the process in the industry. The importance of using welded storage tanks for gasoline is the subject of another article. Here it is pointed out that the time is not far distant until the oil industry will standardize on welded tanks.

OXY-ACETYLENE WELDING OF COPPER, by S. W. Miller—A study of the causes of failures in welding copper, illustrated by micro-photographs. The conclusion is that best results will be secured by using deoxidized copper for the parent metal as well as the filler material.—Acetylene Journal, May.

WELDED STEAM PIPE LINES IN CLEVELAND, OHIO—Details of the construction of a series of welded steam pipe lines welded by the Cleveland Electric Illuminating Company. Since the construction of the first line it is noted that about five miles of welded line have been installed in the down-town section.—Acetylene Journal, May.

GAS WELDED BONDS ON THE ERIE, by C. A. Nichols—A description of the installations of gas welded bonds on the Erie Railroad with cost date showing the average cost of over 17 thousand joints to be slightly less than 43c each.—Acetylene Journal, May.

JOURNAL OF THE AMERICAN WELDING SOCIETY—The April issue contains the text of papers presented before the technical session at the Spring meeting. An abstract of these papers will be found in the report of the meeting on another page.

THE ARC WELDING LOAD, by W. L. Warner—A discussion of the power cost of arc welding and its effect upon the selection of equipment.—General Electric Review, May.

WELDING FOR THE PLUMBING AND HEATING CONTRACTOR, by H. E. Wetzel—A practical discussion of the uses for welding in the plumbing and heating trade. Factors which determine where welding may be used to advantage. A description of several jobs where welding was used with particularly gratifying results.—Domestic Engineering, May First.

SMITH-O-GRAMS—Monthly publication of the Smith Welding Equipment Corporation. In the April issue the repair of a clam-shell bucket, the use of a preheating torch to melt scrap metal, making new fences from old scrap iron.

BURKE ELECTRIC COMPANY BULLETIN 133—Illustrations and descriptions of the current types of Burke electric arc welding equipment. These include a 200 ampere single operator unit, portable, variable, molded types for one and two operators and a gasoline engine driven set. 600 ampere constant potential motor generator sets are also supplied.—Issued by Burke Electric Company, Erie, Pa.

ENGINEERING FEAT CARRIES GAS LINE ACROSS SHIP CHANNEL—Description and illustrations of the welding on a 320 mile gas line of the Houston Pipe Line Company.—National Petroleum News, April 21st.

HIGH TEMPERATURE GAS APPARATUS—Catalog issued under date of April, 1926 by the Harris Calorific Company, Cleveland, Ohio, describes and illustrates a complete line of welding and cutting torches, regulators, gauges, valves and manifolds.

STATEMENT OF THE OWNERSHIP, MANAGEMENT, CIRCULATION, ETC., REQUIRED BY THE ACT OF CONGRESS OF AUGUST 24, 1912,

of The Welding Engineer, published monthly at Chicago, Illinois, for April 1, 1926.

State of Illinois, County of Cook, ss.:

Before me, a notary public in and for the State and county aforesaid, personally appeared H. S. Card, who, having been duly sworn according to law, deposes and says that he is the business manager of The Welding Engineer, and that the following is, to the best of his knowledge and belief, a true statement of the ownership, management (and if a daily paper, the circulation), etc., of the aforesaid publication for the date shown in the above caption, required by the Act of August 24, 1912, embodied in section 443, Postal Laws and Regulations, printed on the reverse of this form, to wit:

1. That the names and addresses of the publisher, editor, managing editor, and business manager are: Publisher, G. H. Mackenzie, Chicago, Illinois; Editor, W. W. Brothers, Evanston, Illinois; Managing Editor, H. S. Card, Chicago, Illinois; Business Manager, H. S. Card, Chicago, Illinois.

2. That the owner is: (If the publication is owned by an individual his name and address, or if owned by more than one individual the name and address of each, should be given below; if the publication is owned by a corporation the name of the corporation and the names and addresses of the stockholders owning or holding one per cent or more of the total amount of stock should be given.) The Welding Engineer Publishing Co., Chicago, Illinois; G. H. Mackenzie, Chicago, Illinois; M. J. Hungerford, Chicago, Illinois.

3. That the known bondholders, mortgagees, and other security holders owning or holding 1 per cent or more of total amount of bonds, mortgages, or other securities are: (If there are none, so state.) None.

4. That the two paragraphs next above, giving the names of the owners, stockholders, and security holders, if any, contain not only the list of stockholders and security holders as they appear upon the books of the company but also, in cases where the stockholder or security holder appears upon the books of the company as trustee or in any other fiduciary relation, the name of the person or corporation for whom such trustee is acting, is given; also that the said two paragraphs contain statements embracing affiant's full knowledge and belief as to the circumstances and conditions under which stockholders and security holders who do not appear upon the books of the company as trustees, hold stock and securities in a capacity other than that of a bona fide owner; and this affiant has no reason to believe that any other person, association, or corporation has any interest direct or indirect in the said stock, bonds, or other securities than as so stated by him.

5. That the average number of copies of each issue of this publication sold or distributed, through the mails or otherwise, to paid subscribers during the six months preceding the date shown above is ..... (This information is required from daily publications only.)

H. S. Card, Business Manager.

Sworn to and subscribed before me this 1st day of April, 1926.

[Seal] William Denzbach.

(My commission expires April 7, 1929.)

For Sale—Welding shop on 15th and Valencia St., San Francisco; rent $45.00 per month, long lease. Equipment valued at $1,100.00. Can be had for $800.00. Doing $450.00 monthly. Owner must be out by June 15th. Address Central Welding Works, 412 Valencia St., Phone Market 1748, San Francisco, Cal.

Position Wanted—Acetylene welder, many years' experience as a mechanic and ten years' experience in oxy-acetylene job shop welding. Can do boiler repairing, blacksmithing, sheet metal welding, auto radiator repairing and laying out and designing. 35 years of age, American; would consider partnership in growing shop. Would prefer work in Alabama, Georgia or vicinity. Address Box 90, care The Welding Engineer.

Position Wanted—Electric and oxy-acetylene welder with 7 years' experience in all around welding and railroad welding work. Capable of training operators. Want permanent position. Address E. M. Schrader, 118 Denver St., Sterling, Colorado.

Wanted—Salesmen handling complete line of welding supplies to sell welding rods and wire, both gas and electric—for large manufacturer, on commission basis. Apply The Seneca Wire & Mfg. Co., Fostoria, Ohio.

For Sale—Fully equipped machine and welding shop and cylinder regrinding. Doing good business, priced right, good reasons for selling. Address F. D. Schluter Auto & Welding Co., Inc., 304-306 N. Gilmer St., Richmond, Va.

For Sale—Service rights on WK and WC Prest-O-Lite cylinders. Large or small quantities. Alfred E. Corp, 40 Mathewson St., Providence, R. I.

Position Wanted—Acetylene welder of 11 years' experience in both railroad and industrial work. Member American Welding Society, Class C, desires permanent situation. Have business experience and have A-1 references. Address 91 care The Welding Engineer.

For Sale—American Turn Auto—a handy machine to roll a car over to a 90 degree angle in a few minutes. A good investment for a shop doing lots of work on cars. Price $250.00. Address Fostoria Welding Company, 319 N. Main St., Fostoria, Ohio.

Wanted—Experienced welder to take half interest in established welding shop. Located in town of 12,000 population with good surrounding territory. Address Fostoria Welding Company, 319 N. Main Street, Fostoria, Ohio.

Partner Manager Wanted

We have a line of goods of interest to the oxy-acetylene trade; have ample capital, but need an active manager; a substantial interest in the business can be bought by the right man for a sum as low as $5,000; business is located in New York, is long established, and in good shape, and present owner is in position to finance it up to its needs.

Address in confidence, J. T. P., Box 534, Palisade, N. J.

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PORTABLE ELECTRIC
DRILL & GRINDER

A money saver and a money maker!
We build only tools that we can guarantee!

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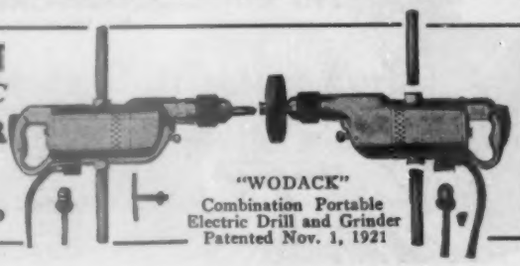

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Combination Portable
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Patented Nov. 1, 1921

PAGE-ARMCO PROCESSED Welding Wire *and* Electrodes

Better Welding *at less cost*

All Page-Armco and Steel Welding Wire and Electrodes are processed and shop tested to meet the exact requirements of the type of work to which they will be placed.

This means doing away with guess work and lost time due to spoiled jobs. It means increased production and better welding at less cost. You can easily prove this for yourself. Write today for interesting information and samples of Page Mild Steel Gas Welding Wire and Electrodes, or Page-Armco Wire and Electrodes, or Page High Carbon Wire or Electrodes. We invite you to test them under the most exacting conditions of your shop. No obligation.

PAGE STEEL & WIRE COMPANY

An Associate Company of the American Chain Co. Inc.
Bridgeport, Connecticut

District Sales Offices:
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Uniform Quality Assured

WELDERS who use Commercial Acetylene soon learn that every cylinder contains the same pure gas.

Your torch can tell the difference!

COMMERCIAL ACETYLENE
Means pure acetylene.

COMMERCIAL SERVICE
Means prompt service.

No matter what your gas requirements may be you will be interested in our sales plan. Ask our nearest office to tell you about it.

Supplied in the following size cylinders:

10x30-in. size	- -	125 cu. ft. cap.
12x36-in. size	- -	225 cu. ft. cap.
12x44-in. size	- -	275 cu. ft. cap.

Commercial Acetylene Supply Company, Inc.

General Office: 80 Broadway
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Wellsworth 464 Welding Goggle

Safety at a low cost

Efficient, safe and comfortable, this goggle meets the demand for a welder's goggle at a popular price. The well ventilated black fibre eye caps are shaped to fit the contour of the face.

Genuine Saniweld Lenses offer adequate protection from harmful Infra-Red and Ultra-Violet rays.

The clear glass cover lenses are separated from the welding lenses by fibre rings to make the goggles cooler and more comfortable. A spring eye wire permits the replacing of lenses quickly and easily.

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The Light of Better Days

The most efficient and attractive spark lighting device ever made, is the new Shoot-a-Lite

Sure, quick and handy, it shoots its light in full volume, just where the light is wanted.

Easy to carry in pocket or on belt.

Made of solid steel, its mechanism is masterful in design, construction, action and strength.

Every man likes to shoot a light with Shoot-a-Lite.

Pull the trigger, feel the click and ring of steel and see the sparks fly.

A welding authority recently said:

"Welders are used to wire lighters, but I find that once a welder gets a Shoot-a-Lite in his hand, he is won to it for all time. It is the last word in torch lighters."

WE INVITE YOUR INTEREST

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SHOOT-A-LITE

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America's Standard

All "Raco" Welding Wires are guaranteed to meet the American Welding Society specifications in every particular, and in addition are subject to rejection from any cause whatsoever.
The well established policy of THE REID-AVERY CO. to specialize in welding wire only insures absolute satisfaction to our customers. Lowest prices consistent with unvarying quality, prompt attention to orders, unlimited guarantee.

RED LABEL (Iron) - - for Oxy-Acetylene Welding
BLUE LABEL (Mild Steel) - - for Electric Welding
HIGH CARBON, for both Arc and Acetylene Welding

THE REID-AVERY CO., Inc.
21st and Washington Ave., Philadelphia, Pa.

Roebling Welding Wire

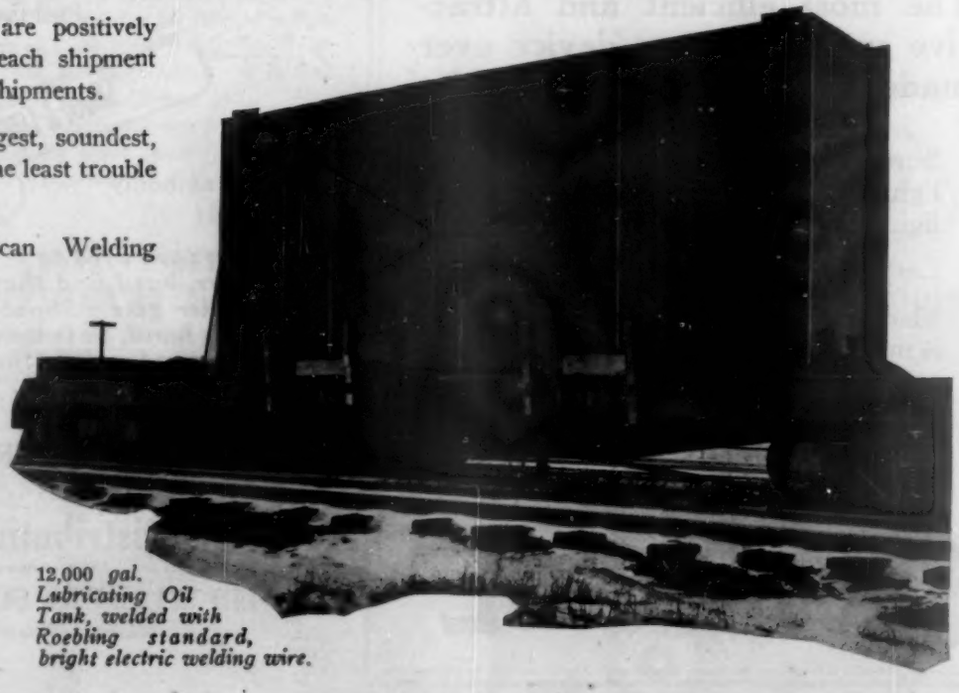
Strong—Tough—Durable

Roebling Electrodes are positively uniform throughout each shipment and throughout all shipments.

They make the strongest, soundest, toughest welds with the least trouble in welding.

Conform to American Welding Society specifications.

John A. Roebling's Sons Company, Trenton, N. J., Makers of Wire Rope and Wire



12,000 gal. Lubricating Oil Tank, welded with Roebling standard, bright electric welding wire.

Weldite

Welding Rod

GREEN SURFACED ELECTRODES

A product of our Research Laboratories which standardizes the working qualities of all types of Electrodes in the Weldite Line. These electrodes are especially surfaced but not flux coated. They produce an arc so stable that they can be used on alternating current as well as direct. The price is the same as the ordinary bare electrode.

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High quality and serviceability have caused Bowers' Helmets and Hand Shields, since 1914, to enjoy largest sales.

The new home of these products is a modern, splendidly, equipped factory with 400% increased capacity.

We offer our unexcelled facilities for light manufacturing to those having suitable specialties.

A welder without a good welding helmet is as well equipped for his work as a a fire-fighter without a hose.

Protection for Welders

The "Safety Service" No. 500 Welding Helmet is light and comfortable to wearer. Made of fibre and fitted with Adjustoweld Welding Glass—with cover glass to prevent pitting of welding glass. Glass easily replaced. The shield which is pivoted to headband may be pushed back over the head when not in use. The Helmet is fitted with Adjustoweld glass which will provide ample protection in any kind of welding. Prices cheerfully furnished on request.

"Safety Service"

No. 500 WELDING HEMLET

THE SAFETY EQUIPMENT SERVICE COMPANY

BUELL W. NUTT, President

1228 St. Clair Avenue CLEVELAND, OHIO

Every Welder Needs

THE MANN MASTER CONTROLLER

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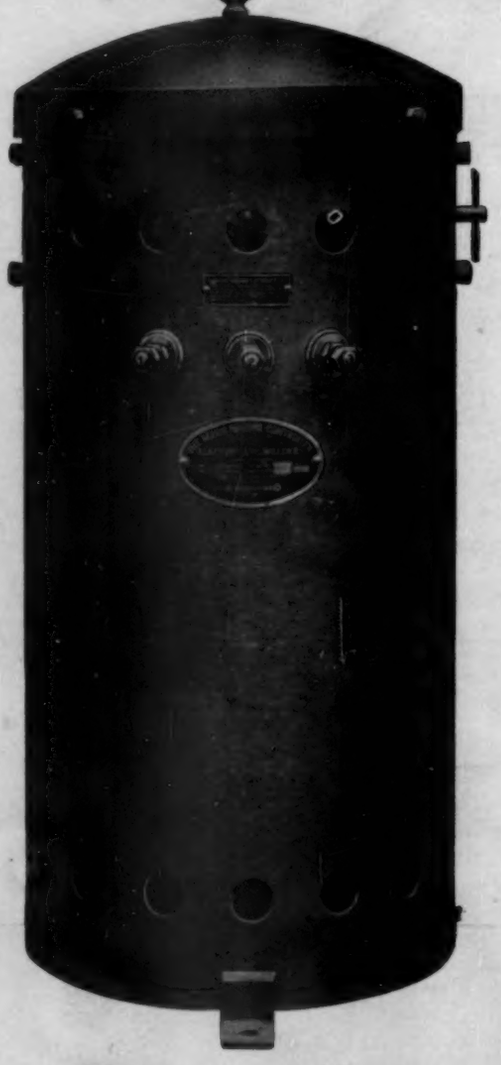
Electric Arc Welders



Because

It produces stronger non-porous welds. Eliminates pores, pinholes and gas pockets.

Saves time, money, wire and speeds production. Prevents leaks and increases current capacity.

Makes overhead, corner and gap welding easy. Welds as low as ten amperes for thin metals.

You may order subject to cancellation within thirty days after test.

Price $210, F.O.B. Pittsburgh, Pa.

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602 Bigelow Boulevard, Pittsburgh, Pa.

SOME MAY COST LESS AT FIRST, BUT---

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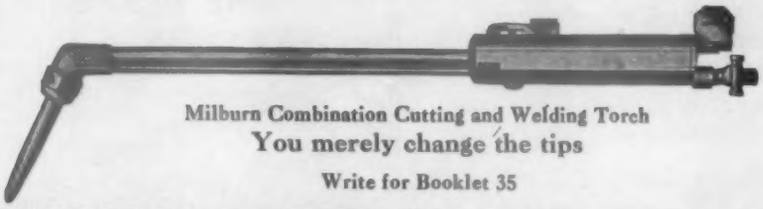

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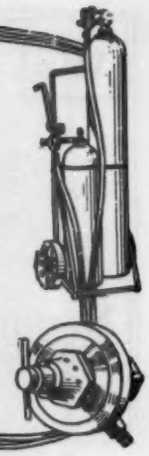

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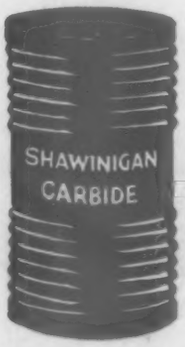

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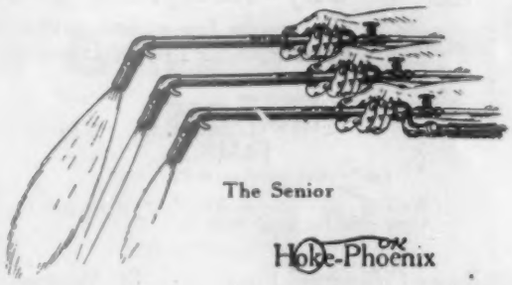

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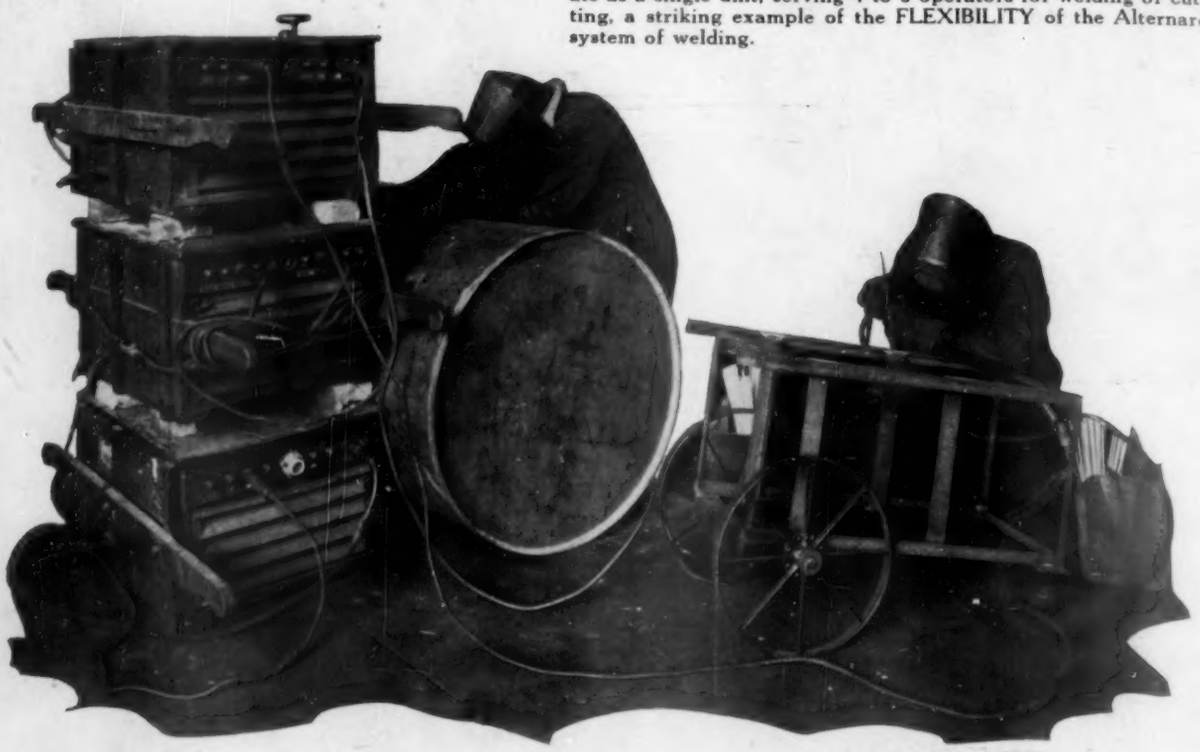

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